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EDITORIAL NOTES.

Professor Bone and Gas-Fire Tests.

IT is always a great pity that, for the purpose of creating argument, anyone should go out of his way to put (with a certain amount of sting in it) a wrong construction on the position and the statements of any one with whom he may be in disagreement or may not be in disagreement so far as he represents. In our "Correspondence" columns in this issue, there appears a letter from Professor W. A. Bone on "The Testing of Gas-Fire Radiant Efficiencies," which letter, he states, he has sent for the purpose of making his own position clear, and, incidentally (we have a genuine right to feel), for the purpose of trying to obscure the position of the "JOURNAL." The editorial published in last week's issue on the subject of the revision of the Leeds test is open to the reperusal of our readers. That editorial seems to have agitated Professor Bone to such a degree that he, in penning his letter, has clearly distorted what was then said. Nowhere in the article did we (as he suggests we did) take up "the curious position that because it [the "Leeds test] demands, 'great care in the manipulation and "'conditions,' the time has come for its revision." We can only express regret that Professor Bone, for what purpose we cannot divine, should have gone out of his way to suggest that this "seemed" to him to be the attitude we took up. Intelligent appreciation of what we did say would have saved the publication of such an absurdity, with the name of our distinguished contributor at the foot. Our point was, as must have been manifest to all other readers, that accumulated experience of the test in practical hands guided by scientific training appeared to suggest that the test required revision and the methods of use somewhat more specific defining (and at most only in the matter of details), in order to make its position as a standard test as impregnable as possible on the point of accuracy. Quite a distinct matter was that the test occupied too long for rapid use on works; and we suggested that, with the view to supplanting present differences that exist in works' gas-fire test methods (not to displace the recognized standard method) an attempt should be made to produce a means for more rapid work which would give results approximate to those obtained by the Leeds test. In these circumstances, we can only feel that it savours of folly to put such a question as Professor Bone does in his letter, "May I ask whether you would advocate "the substitution of some other method that shall not require "care in application?" Not for those readers who already know our answer, but for Professor Bone's information, we reply in the negative, and will add the words, "especially "for a standard method."

The further we go into the opening paragraphs of our correspondent's letter, the more inexplicable to us is the (taking the words of the letter alone) apparent want of perception on his part. So far as we know, no one has ever suggested the revision of the test save in the matter of details. Mr. Hartley has pointed out some, and others—Mr. Butterfield for example—have their views as to certain specific conditions being necessary in order to ensure absolute accuracy under all circumstances. We are open-minded enough to admit that all knowledge does not rest with us, any more than it does with the Lord Chief Justice or any other individual. And we should be sorry to think of Professor Bone being so narrow-minded as to entertain the view that no suggestions for improvements in detail could possibly come from technical men experienced in gas-fire testing, who do not claim enrolment among "experienced physicists." But our correspondent seems to suggest in his letter that, on such small matters as improving details, there could be no association between the technical staffs of the gas-fire makers and "experienced physicists," who should undertake adjustment "as a purely scientific problem." In order that Professor Bone may not say that we have misrepresented him, let us quote his words: "Assuming a good case "is made out, the required revision ought to be under-"taken by experienced physicists as a purely scientific "problem, without reference to gas-fire politics. It is "not a matter that can be negotiated with the man in the "street, nor even with gas-fire makers' technical staffs." We were under the impression that part of Professor Bone's life work has been to bring science to bear upon practice, and practice upon science; and not to teach in any way that the physicist is a superior being who does not require the aid of practical experience. Examining, too, the quoted remarks, we are quite at a loss to understand why, from any commonsense standpoint, any conjunction should be made between gas-fire politics and the suggestion for revision of a test in the matter of details. The only remote connection between the one and the other that we can see is that gas-fire politics have done something to stimulate useful work, and to widen the experience, and therefore the knowledge, of gas-fire testing. Nor can we see that any show of irritation can be conducive to the advancement of anything that is worth having.

From the first part of the letter, we come to a more reasonable part, in which it is seen that Professor Bone himself does not go so far as to suggest that the Leeds method of testing is immaculate. Perhaps neither it nor anything mundane, including any human being whatever his status, can be; but, so long as anything is not immaculate, there is room at any rate for some improvement if it can be devised. The nearer it is to the immaculate condition, the better. In fact, Professor Bone says that, in conjunction with Professor Callender and Mr. Yates (we are justified in reminding our correspondent of his own rule as to the necessity in this matter for the "experienced phy-"sicist), he is "engaged upon the investigation of the pos-"sible application of an independent bolometric method "as a means of checking or standardizing the other." In his lecture at the Manchester University last Saturday, Mr. Yates, also referring to this matter, said: "We are trying "to find either an entirely new method, or some way of "supplementing or perfecting the Leeds method, so as to "eliminate the present small margin of error, and reduce "the time necessary for each experiment." These statements are evidence that our correspondent and Mr. Yates do not regard the Leeds test as infallible, and that they hope to arrive at means for adding to its present degree of accuracy, if not of wholly superseding the test. In perfect agreement with Professor Bone are we that "it would be "foolish to relinquish the old method, except on definitely "proven grounds;" and nothing we have said, when read dispassionately, points to the contrary.

There is one other part of the letter calling for notice, but very brief reference will suffice. Our correspondent wishes to point out that he has "never"—readers will mark this—"at any time given expression to the opinion that it "is not possible to construct a gas-fire which shall pass all "its products of combustion through the flue-vent without "the aid of a chimney draught, and yet not suffer any "appreciable diminution of its radiant efficiency when "subjected to chimney draught." There has never been any suggestion to the contrary, so far as Professor Bone is concerned; for it would have been very foolish for him to have championed such a position, and more especially as, had such construction been impossible, it would perhaps have been beyond the power of certain gas-fire makers to have fulfilled some of their new contracts. Just what he has said here exactly defines the position that we have stated, in general terms, on various occasions, without binding ourselves to any particular construction of gas-fire—not even to the employment of a low canopy. Laying down the premises that "if a fire be so constructed that a large "excess of ventilating air is drawn over the upper portion "of the radiants, thereby cooling them, its radiant efficiency

"must diminish with increasing draught," to say that we have persistently argued to the contrary is not in accordance with fact—not even when we have quoted Mr. W. J. Atkinson Butterfield, to whom our correspondent, with all too evident and unbecoming a sneer, refers to as our "favourite 'authority.'" We are sorry indeed at the tone and attitude Professor Bone has thought fit to adopt in this letter, and which have called for the denial of his assumptions and statements (which do not constitute fair interpretation or representation) as to our position on more than one point.

Mr. Yates on Gas-Fire Construction.

THERE was a great deal that was excellent in the lecture that was delivered by Mr. H. James Yates, before the Manchester Junior Gas Association, on Saturday last at the Manchester University. There is much in it over which the lecturer's fellow-makers of gas-fires will ponder; particularly that part in which warning is given against pursuing radiant efficiency to an extreme that may actually prove to be a disadvantage to the efforts of the industry to further strengthen an already strong popularity. It is easily conceivable that the radiant heat from a gas-fire might be carried to a point that would be so highly concentrated as to be as objectionable to the person as is the high intrinsic brilliancy of the electric metallic filament to the eye. A great deal of attention is devoted by the lecturer to the relative merits of the hemispherical and the one-direction methods of testing gas-fires; and to the gas-fire test record appended to the lecture Mr. Yates attaches value as indicating an important bearing in favour of the hemispherical method. There seems to be some misconception abroad as to the attitude of various experienced gas-fire testers towards the Leeds method. So far as we have gathered, there is not the slightest desire on anyone's part to dethrone it as the standard test, unless something better is found; but there is a natural desire to render it if possible more definite, so as to enable testers to avoid as far as possible any inaccuracy. The lecture will be particularly examined for what Mr. Yates has to say in this connection, and especially by those who have practical experience of the testing of gas-fires.

In a preceding article we have dealt with a letter by Professor Bone on the subject of gas-fires and their testing. In certain respects there are matters in common between the letter referred to and the lecture by Mr. Yates. One of them is found in the effort that is being made to fix the original point of controversy in these columns on to the narrow question of low canopies *versus* high canopies for gas-fires; and in this effort one party to the controversy has the powerful aid of Professor Bone. Part of the difficulty we have had to encounter (so far as our own share in the controversy goes) has been to thwart the repeated attempt to get adrift from the original broad statement that provoked the controversy, which has been developing with somewhat remarkable speed, and has not been without its good effects in several directions. The broad statement suggested the impossibility of constructing gas-fires that would remove, unattached to a flue, all the products of combustion, without losing, when the ordinary chimney draught came into play, an unnecessary number of heat units. Now let us place that statement and one from Mr. Yates's latest utterances in comparison, in order that their relative significance may be fully discerned.

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A fire that carries off all its products *without being attached to a flue* will, when the ordinary chimney draught comes into play, inevitably carry off more than the products—to wit an unnecessary number of heat units as well; and *a lower room-heating efficiency is the result.*	Over a year ago, when the claim was made for a certain construction of gas-fire that it got rid of the products of combustion without the aid of a chimney pull, I criticized *not that object*, but the method of construction by which it was sought to be obtained—viz., by employing, among other expedients, that of bringing the canopy down to the radiants.

These two statements have a somewhat strange contrast. The first of them is as categorical as it well could be; and, as it stands, it was the real source of all the controversy. Since it was made, however, it has been proved to be possible, even with a canopy well away from the tops of the radiants, to construct fires that comply with the very conditions concentrated in the first part of the assertion without the loss of an additional number of heat units, and without a lower room-heating efficiency resulting. Neither Professor Bone nor Mr. Yates, we think, would be prepared to-day to subscribe to the words quoted from the article from Birmingham as published over a year ago. In fact, as pointed out in the preceding article, Professor Bone detaches himself from any such declaration. This being so, the attitude we took up, and (to borrow a few words from Mr. Yates) "steadily adhered to through both contradiction and misinterpretation, the consensus of laboratory tests and practical trial has endorsed." The controversy has fully vindicated the position adopted when challenging the original statement—original in more ways than one.

Industrial Efficiency and the Public Good.

IT is the privilege of the gas industry to be at the very forefront of the campaign for attempting to remove the causes which imperil our industrial stability, and which stand as a permanent menace to the public good. It is also a matter upon which the industry may congratulate itself that two of its very foremost men are always ready and willing, conscious of right and supported by a large practical experience, to carry the tenets of co-partnership wherever, in their belief, its cause, which is also the cause of human progress, will be advanced. It is a good cause, and a very human one. We have at present sitting a conference of the delegates of nations to discuss the momentous problem as to what can be done to mitigate, and to guard against, the perils of the sea. Every unit of the civilized world who unselfishly interests himself or herself at all in the affairs of humanity will wish the conference an abundant success. The foundering of a great ship, and the loss of many lives; the devastating flames on board another ship, and the premature termination again of many lives—these are events that have made the whole world stand aghast; and after the tension caused by the awfulness of the disasters, there has come, and it has grown in strength, the universal and natural desire to do something to lessen such terrible perils. On land all around industry and the public good are ever being imperilled by a condition of things that produces waste, hardship, and distress, to avert which process after process has been applied that has proved abortive in yielding permanent good, while only what Sir Corbet Woodall calls "the realized ideal of co-partnership" has stood firm against the buffetings and shocks produced by the breakdown here and there of the defective organization of the industrial parts. We have had numerous industrial catastrophes with far-reaching effects; but nothing of a really substantial order has been carried out in the way of conference to ascertain whether the problem of guarding against these industrial disturbances is capable of real solution. Sitting in similar way to this international conference with its humane object of ascertaining means of lessening the perils and horrors of the sea, is required one to determine why there has been so much failure of devised means to reduce the perils to industry and to the public good arising from labour storms; which of all the means that have been conceived and tried has proved the most effective; and whether the most effective means cannot be made more universally applicable to industry. All systems such as arbitration and mediation in the world of industrial occupation have admittedly a fundamental defect, in that they imply that there is no basis for perpetual sympathy and concord between employers and employed, and that ruptures and differences are inevitable. While such an admission is implied, there will be those who will ever be seeking grounds and excuses for creating such ruptures and differences.

The two papers that were published in last week's issue by Mr. Charles Carpenter, D.Sc., on "Co-Partnership and Industrial Efficiency" and by Sir Corbet Woodall, D.Sc., on "Co-Partnership and the Public Good" were read and published in their proper order. A strong and indispensable support of the public good is industrial efficiency. As to how much it is so, our economists and sociologists seem to have but a poor comprehension, if the result of all their work in this connection has not produced any more effective political measures than are before us for promoting the one in order to gain the other. What is industrial efficiency? It has not its beginning and end in mechanical operation. It goes much farther. Industrial efficiency has a place in every member and part of the industrial structure—in labour as well as in

the machine; in the master as well as in labour. Strife, and the existence of conditions that make for strife, cannot advance industrial efficiency. They are obstacles to its fullest attainment; and the one is constantly warring against the advance of the other. These are not mere platitudes derived from theoretical thought; but the views of practical observation. There is no need to look far afield, or very far back in our own national history, for the confirmation. It is only by removing the feeling of the hostility of interests, and supplanting it by the recognition of common interests and by the strengthening of the bonds of sympathy between employers and employed, that a state of affairs can be achieved that will promote the highest industrial efficiency.

Co-partnership is a practical way of promoting industrial efficiency, which term in its fullest sense comprises not only quantitative and qualitative output and the application of superlative methods to industry, but continuity of work and service to the community. The highest industrial efficiency cannot countenance anything that hits destructively at the economic conditions of the community, and thus injures the public good. Therefore, if the conditions that exist in the co-partnership companies of the gas industry existed generally, the industrial efficiency of the country would soon be raised beyond measure. The South Metropolitan Gas Company is naturally Mr. Carpenter's example; and there has obtained, since Sir George Livesey introduced his great scheme, the "inestimable blessing of unruffled industrial "peace." These are not the words of a sentimental nature. They are the honest words of a robust practical nature, not devoid of that essential to such a nature—a sympathetic sensibility. Look on this picture, and then look on that. Says Mr. Carpenter in giving illustration: "When the trade "in the Port of London was at a standstill during the great "strike, the Company's tugs and barges went their accus- "tomed way upon an otherwise deserted river; its carmen "delivered coke and gas appliances to its usual customers "when the transport workers all around it were idle. Thus, "unhampered by labour troubles, its officials have been "able to devote their whole energies and their entire re- "sources to increasing the popularity of gas, by improved "methods of production, and by the more intelligent appli- "cation of its uses, to solidify and strengthen the founda- "tion upon which their business stands." Which of the pictures is descriptive of the higher industrial efficiency? Which state of labour during those dreary, seamy-sided days contributed to the greater public good? There is only one answer to these questions. Certain it is that the causes that produced the one state are not the causes that produced the other.

Both Sir Corbet and Mr. Carpenter touched on the several reasons that have tended to the slow progress of co-partnership in the industries generally. Apathy on the part of employers is a salient one; so is the superficial belief, sedulously fostered for purposes of their own by the leaders of unionism, that the system is repugnant to the interests and objects of their organizations. As to the masters, the tenor of both papers shows a belief that the spirit of rebellion on the side of labour against present conditions will in time cause the dispersion—gradual it may be—of the indifference on the other side. The spirit of rebellion is not to be suppressed by rule and regulation, nor by any compulsory form of settling difficulties which are the outcome of something more serious below. The discussion on every possible occasion of the means that have proved effectual in producing contentment in the case of such a large part of the gas industry's workers will help to open the eyes of the country's workers to the truth and efficacy of co-partnership, and will show them that the system is not antagonistic to the real aims of their unions. Union is not the objective of such combinations; the objective is the betterment of the conditions of the members. This betterment co-partnership effects in a quicker and more material way. The betterment sought through the unions as it is gained piecemeal leaves things much as they were, and the road open to the same procedure to gain more, irrespective of common justice as between employer and employed. Co-partnership, on the other hand, while bettering labour through the pocket (of which money-basis, Sir Corbet truly says, the adherents of the system are not ashamed), goes beyond this in its effects—producing a live interest in the concern in the fortunes of which labour shares, a broader and more enlightened outlook, greater interest in the world's affairs, a spirit of equity, and a clearer "perception that we are all members one of "another." Intangible these things may appear to some to-day, save in respect of the money benefits; potent, however, would be their influence on the affairs of the country on the morrow of the application of the system that begets them. Undeniable it is that of all the processes evolved for composing the interests of capital and labour, the only one that has not collapsed under the strain of the times' circumstances is co-partnership, where it has been properly applied. It may not be possible to apply it in common form to all industries; but where the will exists, a way will be found for setting its principles to work. From this would arise greater industrial efficiency; and, in more ways than that, there would be promotion of the public good.

Distribution Topics.

A GREAT deal of attention is now paid to the chemical control of the operations of gas-works, in order to secure the utmost economy. On all too many works, there is much more that can be done in this direction. There is also the distribution department; and in regard to it, the question may well be asked, Is all that is possible being done in connection with it in every undertaking to secure economy? In some districts the answer would be distinctly in the negative; and not only in respect of leakage, but in other ways. In the reply to the discussion on his paper at the meeting of the Midland Association last Thursday week, Mr. W. M. Valon pointed out how at Stafford he had reduced his leakage account to 1½ per cent.; and he attributed this to the care that he takes of the mains and services—services especially. He made the somewhat startling announcement that, in his opinion, at least 90 per cent. of the leakage to-day is from services; and he advised gas managers with a big leakage account to test the services, and the result would open their eyes. The question as to whether, in the event of a big leakage account (big, of course, in relation to pressure), systematic examination would pay, needs no argument. Unless curbed, leakage is continuous, and is likely to increase. It is a continuous waste, and a very definite money waste. Take a works with a sale of only 100 millions, and the high leakage at ordinary pressures of 8 per cent. This leakage is saleable gas (we will say) at 2s. 6d. per 1000 cubic feet; and this represents £1000 a year. Of course, it would be practically impossible to save it all; and there may be argument that the gas only costs so many pence net into the holder, so that it is not £1000 that is actually lost. All the same, it would pay to prevent a large proportion of the waste, seeing that the loss is otherwise continuous.

The distribution system should unquestionably receive just as systematic attention as the manufacturing operations. The subject of the first steps in such attention was considered in a paper that Mr. C. C. Simpson, jun., read at the meeting of the American Gas Institute. In this, he described how in New York the distribution system is protected by a methodical process of street patrolling and examination. The paper is a highly interesting one. The conditions are not precisely the same in New York as in most cities and towns in this country. There is no doubt much more cause there than here for a very strict oversight of the gas canalization. The city is sectionized for patrolling purposes; and an inspector in each section is made responsible for reporting everything likely to affect adversely the gas distribution system in the area under his charge. It is obvious that the expenditure under this head must be substantial; but the gas authorities are satisfied that it is a wise one, and that in the return they obtain full recompense. It must be a healthy and easy sort of occupation for the men. However, they report all street leaks, depressions in pavements, buildings that are being demolished, excavations that are being made—in fact, anything and everything that may in any way threaten the safety of the distribution system. In the year to Dec. 31 last, the total number of matters reported upon by the inspectors was 7590; and the cost worked out to $3 per item. The direct result in the way of saving is not the only one; but the indirect result is something to which a value cannot well be attached. In a city like New York, honeycombed as it is with underground works, the indirect saving must be immense. To be forewarned is to be forearmed; and to have an immediate knowledge of what is going on, and so be in a position to protect the mains and avert damage of unknown character and quantity, is something that is worth more than can be accurately assessed. The New York gas authorities are amply satisfied that methodical daily inspection of this kind upon their distribution system brings to them a good return for the expenditure; and we

can quite believe it does under the conditions prevailing there. In the majority of districts, however, in this country, where there is little underground disturbance, this rigorous and constant patrolling would be a work of supererogation. But it is all a question of proportion in relation to size and conditions. However small and quiescent a gas-supply district may be, it pays to have at any rate periodical systematic inspection, in order to save and protect.

Turning from America to home, a letter appears in our "Correspondence" columns from Mr. George Helps, dealing with the comments in last week's issue principally on the subject of pipe-joints—questions concerning which were raised on Mr. Valon's paper to which reference has already been made. To the discussion on the paper, Mr. Helps, in our opinion, made the most important contribution—not only because he has had a long experience of high-pressure distribution, but because the conclusions he draws from his practice and experience are, on occasion, put forward in such a way that they cannot fail to be suggestive. This must be so generally recognized that there was really no necessity for him to conclude his present letter with the words: "I trust I do no harm in stating my opinions and "beliefs; and, further, I hope that the manner of my "stating them may not detract from their importance." The letter elsewhere speaks for itself, and is explanatory of points raised last week for the very purpose of affording Mr. Helps an opportunity of elucidating certain of his Birmingham utterances. The most important was the one in which Mr. Helps declared that the welded joint was the cheapest form; and his letter shows that our surmise was right, that he meant cheapest in the long run. "It is not "only," he remarks, "the best for twenty-four hours, but "the best for all time and all circumstances."

The Bane of "Lancet"-ese.

A POPULAR daily newspaper last week coined the word "Lancetese" to express the ponderous diction and alarmist tone which the "Lancet" from time to time adopts in the endeavour to warn people as to hidden terrors of which they would not even dream but for its grim fairy tales. But "Lancetese" has been overdone. It has ceased to create a scare even among somewhat nervous people, and at best now serves merely to amuse. It is fortunate for the reputation of medical practitioners for good judgment, broadmindedness, and common sense that they too do not take these diatribes of the "Lancet" seriously, but regard them properly as the efforts of academical brethren more or less cut off from the experiences of practice, and hard put to it to provide "copy" which will attract attention outside the medical profession, and secure a dubious *réclame* for their journal.

A baneful example of "Lancetese" appeared on the 1st inst., under the heading "The Bane of Sulphur in Gas "Supply;" and the "Electrical Times" would fain have it accepted as the considered pronouncement of eminent medical specialists. Our electrical contemporary should display better judgment. In the article in question, the "Lancet" avers that "sulphur dioxide or trioxide is a most objection-"able constituent of the products of combustion [of gas]. "It is not only a constituent which corrodes metal fittings, "attacks books, ceilings, and many domestic appurten-"ances, but it is also objectionable to the respiratory "organs." It proceeds to argue that the gas companies, in their own interests, and in those of the public, should remove the whole of the sulphur impurities from the gas supplied. It quotes a number of figures, evidently taken from the volume of lectures on "Chemistry in Gas-Works" by Mr. W. J. Atkinson Butterfield, recently published by the Institute of Chemistry, as to the average proportion of sulphur in London coal gas before and after the sulphur restriction clauses were repealed. The quotation shows that the sulphur compounds in London coal gas in 1912 averaged 24½ grains per 100 cubic feet. The partial knowledge of the writer in our medical contemporary evidently leads him to the belief that this proportion of sulphur is highly detrimental. We will not essay the task of convincing him or our electrical friends who are so jubilant over his efforts; but in order to prevent members of the public being misled for want of a refutation of the statements, we will show in a few words the fallacies which the writers in the "Lancet" and the "Electrical Times" are entertaining.

If they had turned to the lines above those in the reprint of Mr. Butterfield's lectures from which their data for the sulphur in London gas are quoted, they would have seen that the air of an occupied gas-lit room, ventilated according to the Factory Inspector's standard, cannot contain more than 24½ volumes of sulphur dioxide (including trioxide, if any) per 100 million volumes of air when the gas contains 24½ grains of sulphur per 100 cubic feet. That is to say, the maximum proportion of sulphur dioxide attainable from gas in an occupied room efficiently lighted by it is 0·00245 volume of sulphur dioxide per 10,000 volumes of air. Actually, for well-recognized reasons, the proportion of sulphur dioxide found in the air of rooms is very much less than the theoretical maximum given by Mr. Butterfield. It is generally stated, on the authority of Lehmann, that 0·3 to 0·4 volume of sulphur dioxide per 10,000 volumes of the air breathed will irritate the respiratory organs of persons unaccustomed to it. Even as little as 0·06 to 0·1 volume of sulphur dioxide per 10,000 of air may cause an unpleasant feeling of irritation of the nose and throat, especially at first. Notwithstanding these statements, on which the authorities on hygiene rely for their arraignment of the sulphur in gas, it was proved, in connection with the Metropolitan Railway tunnels before the introduction of electric traction, that the presence of 0·1 volume of sulphur dioxide (in addition to other impurities, which do not arise from gas-burners) per 10,000 of air in the tunnel produced no permanent ill-effects, nor shortened the life of any healthy person. To quote a report by Dr. J. S. Haldane, F.R.S., on the composition of the air in these tunnels: "The men em-"ployed on the line are exceptionally healthy." Likewise, according to the same report: "Occupation in factories "where sulphurous acid is present in perceptible propor-"tions in the air seems also to be unattended with danger "to health." Thus we see that, according to Dr. Haldane, whose authority on such a question even the "Lancet" can scarcely pretend to disregard, forty times the maximum amount of sulphur dioxide which modern gas lighting can give in the air of a room is uninjurious to the health of occupants, even when accompanied by other and very real impurities.

The strange irony of the situation, however, to which the writers in the "Lancet" and the "Electrical Times" appear to have been totally oblivious, is that, according to analyses made by Mr. Otto Hehner, the normal London atmosphere in winter contains from 0·002 to 0·005 volume of sulphur dioxide per 10,000 volumes—*i.e.*, a quantity as large as, or larger than, the maximum which the sulphur in London coal gas can produce in the air of a gas-lighted room. The sulphur dioxide, thus normally present in the winter air of a big city in greater proportion than gas lighting can possibly produce, is derived, of course, from the coal which is burned in domestic fires and factory furnaces, and, among the latter, the electricity generating stations constitute an important element. The hygienic ideal would be the suppression of the combustion of raw coal; and the "Lancet" would be well-advised to turn its energies against the electricity generating stations which belch forth the products of combustion of thousands of tons of such raw coal, heavily laden with sulphur dioxide and sulphur trioxide, which would have been to a large extent extracted, retained, and utilized had the coal been carbonized on gas-works instead of being burnt at these stations. The maximum attainable vitiation by gas of the air of a room lighted by modern burners is, from the hygienic standpoint, a negligible item in comparison with the general vitiation of the atmosphere of cities, to which the electric light undertakings are large contributors. The corrosion of metal work, leather, &c., goes on through mere exposure to the London atmosphere, and electric lighting does nothing to abate it, as the foregoing considerations show. Even the metal work of an inverted gas-burner, which is fully exposed to the products of combustion of gas when they are hot and concentrated, has a life of at least eight to ten years; while we have seen the brasswork of electric fittings which have been exposed merely to the warm moist air of a London bath-room rendered unsightly and useless in less time.

It is questionable whether yet more highly purified gas than that which is supplied at the present day would reduce to any appreciable extent the corrosion of the metal work of gas-fittings, since this is in no small measure due to the corrosive action of the air and dust of cities. If "Lancetese" has not yet lost all power for good, it might well be directed against electricity supply undertakings and other big consumers of raw coal for their large contributions to the corrosiveness of city atmospheres. This is a matter in which every city dweller and worker is concerned, be he gas consumer or no.

The questions whether the gas consumer can afford to pay for a still higher degree of purification of the gas he uses, and whether he will reap any appreciable advantage therefrom, are best answered for him by the men who direct the gas industry, and have an expert knowledge thereof, to which the writers in the "Lancet" and the "Electrical Times" cannot pretend. If anyone who is already a gas consumer, or who is thinking of becoming one, is in doubt as to whether the gas supply is sufficiently pure (or otherwise of a suitable grade), he should discuss the matter with the gas department, whose interest and duty it is to give the best possible supply at the lowest possible price. Naturally our electrical rivals would dearly like to see gas become an expensive luxury owing to the cost of ultra-purification such as that which has been advocated in "Lancetese."

Gas at the Anglo-American Exhibition.

The months are not many before the Anglo-American Exhibition will take its place among the things that claim popular interest. The idea of celebrating the centenary of peace and of progress in the arts, sciences, and industries of the United States of America and the British Empire appears to be receiving very favourable attention. The electricity industry is well forward in time in making arrangements for a display on the occasion, although it cannot, as an industry, claim a century's existence. It is, however, an important product of the century. In this instance, the electrical industry has been like the bird of excellent matutinal habits who obtains the best selection of meaty food. Through being betimes, it has got the pick of places in the Central Hall at the Exhibition. This was pointed out by Mr. Charles Carpenter, D.Sc., in his letter and plan published last week, in which he invited the gas industry to promptly consider the question of representation at the exhibition. As communication has been made by him on the subject to the President of the Institution (Mr. Edward Allen, M.Inst.C.E.), it may be we shall shortly learn something definite in regard to it. Meanwhile, we unofficially hear that the Directors of the South Suburban Gas Company have given Mr. Carpenter encouragement to press forward with the matter; and this, we believe, has been done without any prior knowledge by, or communication with, Mr. Carpenter on the subject. Seeing that he is a member of the Board, it was a graceful thing on the part of the Chairman (Mr. Charles Hunt) and his colleagues to resolve, on the day their colleague was away at Leeds in the cause of co-partnership, to offer the South Metropolitan Gas Company financial co-operation to an extent proportionate to the respective gas sales of the two undertakings, should it devolve upon that Company to represent the gas industry at the exhibition. We hope, however, that it will not fall upon South London to solely represent the century-old gas industry at an exhibition where its presence would be particularly apposite and (it seems to us) extremely advantageous. We hope that, pending an official decision in the matter, other gas undertakings will tender their support, after the manner of the South Suburban Company.

Promoters of Gas Bills and the Residuals Restriction.

We hope that, in the preparation of Bills for the coming session, promoters will take care that their Parliamentary Agents do not adopt the new model general purposes clause, which only provides for the conversion, manufacture, and sale of residual products, and is therefore, so it appears to us, opposed to the decision of the Joint Committee of the two Houses. The Committee were distinctly in favour of complete liberty in the matter of transactions in residual products as between gas undertakings; and, to ensure complete liberty, nothing short of the clause that was in existence before the chemical manufacturers' attack on freedom of trade in gas residuals should be sought. This clause was in these terms: "May provide, purchase, sell, dispose of, and deal in gas, coke, tar, and all other residual products resulting from the manufacture of gas." Reference to the altered model clause was made in our leader columns for Nov. 4; and, in view of the preparation of Bills just now, it is as well to emphasize the point. While doing so, mention may be made of three Acts among those noticed this week. When introduced, we called attention to the fact that the three Bills, despite the decision of the Joint Committee, contained the restricting words "by them" in the general purposes clause, as well as in the construction and maintenance of works clause. From the general purposes clause in the Acts, the words have disappeared; but in the works clause they are retained. This must have been an oversight. The result, however, it seems to us is that, while the three companies are given power to generally "deal in" residual products, they may only "manufacture and convert all residual products resulting from the manufacture of gas *by them*."

Undeveloped Areas.

In recent times, it has been observed that the Parliamentary Authorities have got a bit tired of the fighting that goes on in the Committee rooms between new and old companies regarding territory over which the latter have long-standing unexercised statutory rights, which they still wish to preserve for themselves for exploitation at their own pleasure. This is unfair to the districts concerned, providing that the willing suppliers are prepared to undertake the business on proper terms. Parliament has not, under such circumstances, been disposed to side with the "dog-in-the-manger" companies; and such companies generally nowadays find themselves defeated when Parliament is called upon to adjudicate between the would-be suppliers and those who have been in possession so long without having made any movement. It is probable that henceforth, where the new limits of supply include virgin area, Parliament will place a time-limit upon the preservation of rights over undeveloped territory. The movement is seen in the group of Acts that are under notice in our columns to-day. In the case of the Titchfield Act, for example, it is provided that if, after five years, the Company have not laid mains for the supply of certain parishes, nothing is to prevent any company, person, or local authority obtaining statutory power for the purpose; and the Titchfield Company are prohibited from opposing such application, other than upon details. The same thing is found in the Bournemouth Company's Act in regard to the supply of water in the extended area; but in this case the years of grace are seven. With five years' protection, like conditions apply to an extension of the area of the Grays and Tilbury Gas Company. Further instances may be found as we pursue our investigation of the Acts.

Progress in Canada.

Particular pleasure will be felt by those who met Mr. Arthur Hewitt during his visit to this country last year (when, it will be remembered, he took part in the proceedings at the meeting of the Institution of Gas Engineers), on learning of the remarkable progress that is being made by the Consumers' Gas Company of Toronto, of which he is General Manager. The undertaking has a history extending over much more than half-a-century; and the twelve months to Sept. 30 last have provided the largest expansion of business that has been experienced in any year during this long period. The magnitude of the operations now carried on is sufficiently shown by the report and the remarks made by the President at the meeting; and how the present compares with the past is convincingly set forth in a neat little collection of diagrams. From 4 miles of street mains in 1847, the system has grown to 521 miles now—no less than 36 miles having been added within the past twelve months. Whereas in 1850, there were no bigger mains used by the Company than 6-inch, the largest now employed are 48 inches in diameter. The increase in the output of gas recorded on the present occasion is over 10 per cent. compared with the preceding year; and close upon 8000 new services were put in. Under such flourishing conditions of business as these figures reveal, it is not surprising that the Directors should be looking even beyond the substantial additions to the manufacturing plant already in hand.

Stored-Up Sunlight for Night Illumination.—According to a paragraph in last Saturday's "Pall Mall Gazette," an ingenious suggestion has been put forward in the "Scientific American" in regard to the illumination of streets at night. Briefly, the proposal is that if a little attention were devoted to the phenomena of phosphorescence and fluorescence, it should be possible to prepare substances which would store-up sunlight during the day and return it during the night; thus bringing about a perfectly automatic equalization of the solar-light energy over the twenty-four hours. Our contemporary says: "The sulphides of calcium and strontium possess this property to some extent. The problem is to develop it sufficiently to enable such stored-up sunlight to take the place of artificial lights in our streets at night. When such a material is discovered, all that will be necessary will be to prepare it as paint, and coat the surfaces of all buildings and blank walls with it." This is a revival of the old "luminous paint" idea.

OBITUARY.

The death occurred last Tuesday of Mr. JAMES K. HESKETH, the Chairman of the Northwich Gas Company. Deceased had been on the directorate since 1908, and had occupied the chair for the past two-and-a-half years. The interment took place at Knutsford last Thursday, and the Company were represented by Mr. C. T. Eachus (Deputy-Chairman), Mr. P. Flannery (a Director), Mr. J. A. Brentnall (Engineer and Manager), and Mr. P. S. Welbourn (Secretary).

The Reigate Gas Company have sustained a loss by the death of their Chairman, Mr. F. BUDGEN. Deceased was a native of the town, and for many years carried on business there. He entered the Town Council in 1876, was elected Mayor in 1884, and re-elected the following year, when he was made an Alderman. He had been on the Borough Bench since 1885, and had the honour of Chief Magistrate conferred upon him in 1892. A large number of institutions and organizations in the borough claimed, at one time or another, the value of his support.

The death occurred, from pneumonia, on Saturday evening, of Mr. RICHARD HERBERT TOWNSLEY, the Manager to the Leeds Corporation Gas Department. About three weeks ago he caught cold, but was able to attend a Committee meeting on the 28th ult. Later he attended a football match; and it was after this pneumonia set in. Mr. Townsley, who was 51 years of age, and a native of the city, had been connected with the Leeds gas undertaking all his working life. He was educated at the Leeds Grammar School; and in 1889 he became a pupil of Mr. Henry Woodall, then Gas Engineer to the Corporation. In the early days, he was in the chemical department; but in 1888 he was appointed Manager of the York Street works. In 1895, he succeeded Mr. James Lupton as General Superintendent of all the gas-works. Shortly afterwards the title of the office was altered to General Manager, and the duties slightly re-arranged. He came to the undertaking at a critical time. His first Chairman was Mr. John Tweedale, who a year later was succeeded by Mr. Joseph Lowden. Under Mr. Townsley's direction, stoking machinery was put in at New Wortley about 1896; and inclined retorts have since been installed at Meadow Lane, York Street, and New Wortley. The works and plant have been entirely modernized. Mr. Townsley was recognized as a persevering, conscientious public servant; and he proved himself to be an excellent business man. In dealing with the important department of residuals, it is said that he saved the city considerable sums; and he has enjoyed the full confidence of successive Gas Committees. He leaves a widow, four daughters, and two sons. The funeral takes place to-day.

ELECTRICITY SUPPLY MEMORANDA.

THERE is genuine alarm in the electrical press over the spreading knowledge that the quality of gaslight is superior to that of electric light, and that the injurious effects of the latter light upon the eyesight are much greater than those of the former. To controvert this knowledge, the papers which have touched upon the matter think that bluster and bluff are quite good enough for the disposal of a really, for the electricity supply industry, serious question. The "Electrical Times" says that nothing is "too silly" for the "man in the street." To which we reply that nothing appears "too silly," in connection with the question under consideration, for our friends of the "Electrical Times" to serve up to the technical men of the electrical industry. The "Electrical Review" brings some more of its pseudo-notions as to what are scientific actualities to bear upon this important question—just as it did when referring to what happens when gas under very high pressure escapes from the gas-cylinders used for train lighting, and when it sought to enlighten its readers as to the conservation of heat in the electric-oven. Is it wise on the part of the speakers for the electrical industry to try to burke this matter of the relative effects of sources of artificial light upon the visual organ by their silly bluster and bluff? They perhaps know best their own business and the weakness of their own case; but we are entitled to an opinion as to the wisdom of such a policy. Doctors are getting better informed on the subject; ophthalmists have been forced recently to look closer into the question than formerly by the growth of defective vision, and to ascertain the cause; and the public feeling the effects is getting distinctly perturbed. We have ourselves met with members of the public who have been compelled to recognize the impairing effect on their eyesight of the electric light; and our advice has been that the quickest way of averting further trouble is to incur additional expense and put a barrier between such lights and their valuable eyes.

Eyesight and Genuine Alarm.

It would be far better for the electricity supply industry to face at once the fact that its lights have this bad effect upon the eyesight—more perhaps through the high intrinsic brilliancy than the composition of the light itself—so as to encourage scientific installation in place of crude installation, than to let the discredit that is already on the wing gain additional speed and increased confirmation. In our travels from home, we see that certain of the electrical engineers are more discreet than those who conduct their technical journals; for they are quietly working for the adoption of indirect or semi-indirect methods of illumination, and for enclosing electric incandescent lamps in diffusing glassware. On the other hand, there are many electrical engineers who are absolutely indifferent over the matter, and still put in naked electric bulbs wherever they possibly can—defiant of the result, and callous as to the future interests of the electricity supply industry and of human vision. It is said by the "Electrical Times" that "naked gas mantles and [electric] glow lamps are no longer paraded in the direct line of vision, except by Hottentots." From the point of view of intrinsic brilliancy alone, there is a broad difference between the gas mantle and the electric metallic filament; so that if our contemporary had alluded to the electric lamp solely, it would have been sufficient. If we accept the description applied to those who fix and use metallic filament lamps in the direct line of vision, then there are numerous Hottentots among the electrical fraternity as well as among the users. Another senseless statement by our contemporary is: "Strange to relate, they [the customers of electricity] use the metallic filament lamp to see by; not to look at." Our friend should study in this matter first the effects of metallic filament lamps, and then the causes of these effects, in order to obviate any representation on his part that he is adrift on this subject, and is possessed of greater ignorance than knowledge in regard to it.

Silent Work and Indifference.

What has produced the present violent outburst on the part of the electrical press against those who, in the cause of the preservation of the human sight, dare to call attention to the demerits of the electric light applied in its naked form? It is the statement of an oculist to a representative of the "Birmingham Daily Mail" that the "incandescent gas light is less hurtful to the eyes than the electric light on account of the ultra-violet rays of the latter." This oculist is electrically written-down as an ignoramus on the subject; and yet he ought to know as much of the subject as, if not more than, those who admonish him in the electrical press. We have never made over-much of the ultra-violet ray argument, believing that a vastly more serious question is the high intrinsic brilliancy of metallic filament lamps. But our electrical contemporaries should apply to their consideration of this question a little more knowledge of light diffusion, concentration, and composition, instead of continuing to advance as sufficient the bald contradictions which they keep in stock for the purpose of dealing with assailants. We have the "Electrical Times" referring to daylight. "Daylight," it says, "is so rich in ultra-violet rays that it must be extremely injurious to the eyes—much more so in fact than electric light, and naturally far more so than gas." Many thanks for the acknowledgment regarding gas. But does our contemporary see no difference, in regard to the effect on eyesight, between the diffusion and composition of daylight and the concentration and composition of the light of a metallic filament lamp? Does it see no difference in exposing the eyes to the one and then to the other at close quarters in a confined room? Not only the ultra-violet rays but the total composition of light is a matter for consideration. Later in the article our contemporary quotes Dr. Steinmetz to the effect that irritating and fatiguing effects are peculiar to orange, red, and especially to ultra-red radiation; and a little further on it cites figures by Dr. Voege which show that the metallic filament lamp far outruns incandescent gas-light in red and especially ultra-red radiations, which produce what Dr. Steinmetz calls irritating and fatiguing effects. Taking the natural light of a cloudy sky as unity in each colour, the following comparisons are recorded by Dr. Voege:

Ultra-Violet Rays.

	Blue.	Green.	Yellow-Green.	Red.	Deep Red.
Tungsten filament.	0·23	0·86	1·0	1·63	2·10
Incandescent gas .	0·23	0·89	1·0	1·20	1·13

Now there is proof indeed, if Dr. Voege is correct in his figures, and Dr. Steinmetz is correct in his assertion as to the effects of the red and ultra-red radiations, that the tungsten lamp will cause greater offence to the eyes than the incandescent mantle. But are Dr. Voege's figures trustworthy? Where is the violet in his relative quantitative compilation? In white light there are the elementary colours violet, blue, green, yellow, orange, and red; and daylight contains invisible rays, such as ultra-violet and infra-red. But Dr. Voege's figures ignore the violet; for it is clear that, contrasting the results with those of other investigators, he has not merged the violet in the blue. The case for the metallic filament grows worse with investigation, and not better; and the farrago of the "Electrical Times" assists in making it worse.

The Science of the "Review."

In passing, we cannot avoid having a little tilt at the "Electrical Review," although we ought to be thankful to it, for lately its incursions into what it regards as the science of things must have caused others besides ourselves no little amusement. In dealing with the ultra-violet ray question (it says nothing of Dr. Steinmetz's views as to the red and ultra-red radiations), our contemporary remarks that "although the fact is probably well known to all our readers, it is necessary once more to state that ultra-violet rays *cannot* penetrate even a thin layer of glass." Again, "it is a physical impossibility for any incandescent

electric lamp to emit the *least* trace of ultra-violet rays. Arc lamps are also invariably provided with glass globes completely surrounding the arc, and are therefore equally guiltless of the emission of ultra-violet rays. . . . It is therefore an incontrovertible fact that electric lamps of whatever kind *never* emit ultra-violet rays." Will the glass pass the red and the ultra-red rays? The "Electrical Review" will perhaps supply the answer. But after such a weighty pronouncement on the incompetency of the ultra-violetray to force a passage through glass, what else is to be said? Mr. E. Treacher Collins, F.R.C.S., L.R.C.P., the oculist consulted by the House of Commons to advise as to whether the fixing of metallic filament lamps in the roof of the House would have any bad effect on the eyes of the honourable members during the hours they sit and are awake in the House, would perhaps not have made the report he did had he consulted the "Electrical Review" before doing so. Perchance he would still have done so, and, at the same time, would have extended a little sympathy to the "Review." However, he stated that the ultra-violet rays "may" produce irritation of the eye. The "may" was no doubt a concession to those who dearly wanted the electric light installed. Mr. Treacher Collins then proceeds to say that these ultra-violet rays are "to a great extent"—not wholly, but "to a great extent"—cut off by the passage of light through glass, and are completely cut off by glass of an amber tint. The eyes of our legislators are protected against the ultra-violet rays by the glass of the lamps, by the lamps being hidden by means of Holophane globes, and by these being suspended above the amber glass roof of the legislative chamber. The eyes of members of the House have three lines of defence. Is the "Electrical Review" prepared to call Mr. Treacher Collins a fool?

Authorities. At the recent International Medical Congress, Dr. J. Herbert Parsons, Ophthalmic Surgeon and Lecturer at University College, described "Photophthalmia" as a name he had invented to express eye inflammation produced by exposure to artificial sources of light which are rich in ultra-violet rays—such as the naked arc electric lamp, the metallic filament lamp, and the mercury vapour lamp. At the same congress, Dr. Kerr said he agreed that the electric light contained rays which were peculiarly irritating to the retina. Dr. Ellice M. Alger, Professor of Diseases of the Eye in the New York Post-Graduate Medical School, says: "Most of the more recent artificial lights, whether gas or electric, contain a much higher proportion of the short violet and actinic rays, and some of them contain many of the ultra-violet rays as well. . . . Prolonged exposure to the electric arc light sometimes produces an intense conjunctivitis, with contraction of the pupils and erosions of the cornea, which fortunately generally yield readily to treatment." Also "many people have had their eyes permanently ruined by incautious watching of an eclipse, and similar damage sometimes follows exposure to electric flashes, and even too long exposure to the arc light." Mr. Treacher Collins, Dr. Parsons, Dr. Kerr, and Dr. Alger should sit at the feet of the "Electrical Review," and learn.

Intrinsic Brilliancy. But apart from all questions as to the effects on the eyes of the ultra-violet rays and the red and ultra-red rays, we have had it clearly established by Dr. Ives, Mr. T. Thorne Baker, and Mr. Robert ffrench Pierce that the light emitted by the incandescent gas mantle is a much nearer approach to daylight than any other incandescent light source; and therefore that it is the most economical and reliable means of producing artificial daylight. Then, again, there are no two questions as to which form of light has the higher intrinsic brilliancy, which we regard as an even more serious question than that of the effects of the ultra-violet or ultra-red rays—bad as they are. Several authorities have given definite figures on this point of intrinsic brilliancy. Dr. Ives is one of the latest; and therefore we may quote him. An incandescent mantle (low pressure), he says, has an intrinsic brilliancy of 35 candles per square inch; a tungsten filament about 1000 candles per square inch; a patch of sky, 2 to 3 candles. Professor Silvanus Thompson has well described the effect of intrinsic brilliancy on the eye. He says that if one takes two sources of light of equal candle power—the one a small source, the other a large one—there is by the one lamp a strong stimulation over a small patch of the retina, by the other lamp a weaker stimulation over a larger patch of the retina. The bedazzlement of the eyes by lights that are highly concentrated is, he adds, very undesirable. In our opinion, it is due to this, that there was such a strong consensus of expert opinion at the recent International Medical Congress that there is a modern rapid growth of defective vision. Dr. Parsons said he thinks the eye trouble is more acute, and is being met with more frequently. Dr. Brindley James says that since electricity has been substituted for gas at a training college of which he is the Medical Officer, the eyesight of the students has been very much affected. Dr. Lawson thought that more attention should be paid to the effects of ultra-violet rays. Dr. Wainwright asserted that a great deal of eye trouble was due in modern days to the irritating effects of electric lights and unshaded lamps. Over in America, Dr. Charles Oliver, the Ophthalmic Surgeon to the Wills' Eye Hospital and the Philadelphia Hospital, has given an unequivocal opinion, from the point of view of eyesight preservation, in favour of gas lighting. Dr. Meredith Young, the Medical Officer of Health and Chief School Medical Officer of the Cheshire County Council, has through experiments on himself, shown how his visual acuity is more strongly affected by electric incandescent lamps than by incandescent gas-lamps. The same result has been found by Dr. Cameron Gibson. Lord Rayleigh, too, recently said: "Artificial illuminants are not too diffused, but too concentrated—particularly in the case of the modern electric lamp, in which a large amount of light is given from an exceedingly small filament. With gas, the difficulty is not so great." From all of which it is seen that the diffusion of knowledge increases on the subject of the metallic filament and eyesight injury. Against this knowledge the efforts of our electrical contemporaries to mitigate (on paper) the subtle effects of the metallic filament lamp has a puny, weakly appearance. If they are sensible, they will make better use of their time and energies in urging the speedy adoption of means to counteract these effects—though the installation of the means necessitates greater cost to the user. Better monetary cost than visual cost through neglect.

Barbarous Lights. America does things on a big scale. It is going to demonstrate, with a fullness that in itself almost dazes one, that electric lighting is a barbarous method of illumination unless it is screened from the optical organ. The demonstration is still some distance ahead; and the scene is to be the Panama-Pacific International Exposition of 1915. The illumination is to be by indirect means. We cannot vouch for the accuracy of the details; but what is reported is that artificial daylight, produced by diffused and reflected electric light, will bathe the entire grounds. Though almost 4 billion candle power—4 billion is right according to the printed authority—will be used, there will be no glare or unprotected light to tire the eyes. Most previous expositions have been illuminated by uncovered arcs, searchlights, and outline strings of electric bulbs on the exterior of the buildings. The result (so the newspaper informant avers) has been much glare and a great distortion of architectural and sculptural effects at night because of dark spaces and shadows. There will be no outlining at the Panama-Pacific Exposition. The exteriors of the buildings will be illuminated by thousands of arcs on standards. On top of each standard, clusters of arcs will send out 8000 to 10,000 candle power. Canvas banners, white on the inside and elaborately painted on the outside, will shield the arcs and reflect their light upon the buildings' façades, bringing out the architectural detail clearly and uniformly. In the centre of the courts, large fountains of dense white glass, with waterfalls near their bases, will shed a soft, even, diffused white glow over water and grounds. Two of these fountains, with glass columns 70 feet high, and arcs developing 50 million candle power, will stand in the Court of the Sun and Stars. If good fortune only leads us to the Court of the Sun and Stars in 1915, we shall feel greatly obliged to the projectors of this scheme of illumination for taking early thought for our eyes.

An Efficiency Error. Professor Howe has called attention in the "Electrician" to a very common error; the error having been perpetrated by our contemporary at least three times in reprinting parts of an American paper on the efficiency of tungsten lamps. The mistake concerns efficiency. One of the sentences that Professor Howe takes as illustration is this: "The average efficiency during life being *more than* 0·5 watt per candle power." The literal meaning of this is that the consumption per candle power is greater than 0·5 watt. What, however, the author really means is that the efficiency is more than one candle power per 0·5 watt; and that is not what he says. Professor Howe holds that if the term "efficiency" is to be retained, "it should be in candle power per watt; but if the watts per candle power must be given, then it should be called the specific consumption, or merely the consumption." We may as well learn to say correctly what we mean. Of all the technical papers to be least trusted for accuracy, the American ones take the lead—both in expression and figures. Perhaps our contemporary will in future edit with a little more care material bagged from American sources.

Saline Corrosion of Gas-Retorts and Coke-Ovens.

In the "JOURNAL" for the 2nd of September (p. 617), it was mentioned that Herr Zinck, of Halberstadt, had drawn the attention of the Association of Gas Engineers of Saxony and Thuringia to what he called the "saline corrosion" of gas-retorts and coke-ovens. The following letter on the subject, from a correspondent who signed himself "Adsum," appeared in the article on "Gas Engineering" in the Engineering Supplement to "The Times" last Wednesday:

At many coke-oven plants walls have had to be replaced in less than a year, owing to the action of the salt. Washing cannot remove the salt, and all bricks are more or less susceptible to its action. Thousands of pounds are expended every year in replacing walls damaged by salt corrosion, and much money has been spent on experimental work with the object of finding a suitable preventive. It is not the percentage of salt in the washing water which matters at all; that is not beyond remedy. It is the amount of salt which is so closely incorporated with the coal that it cannot be removed by ordinary washing operations which counts. Indeed, in many cases the salt can only be removed by repeatedly extracting the very finely powdered coal with boiling water. There are districts in this country where the coals contain almost 1 per cent. of soluble salts.

GAS ACTS FOR 1913.

[First Article.]

There has been a little unavoidable delay this year in reviewing the Gas Acts, owing principally to the National Gas Exhibition claiming attention just at the time that prints of the Acts were available. However, we can begin this week to complete the record of the session's work by reviewing a number of the Acts for the purpose of showing what changes, if any, have been made in them, and not with the intention of referring to their contents in detail.

The first measures to be noticed are those in which companies sought incorporation. These Bills were freely dealt with on Jan. 7 last (p. 29). The promotion with which we led off on that occasion was that of the Ely Valley Lighting Company, which was subsequently dropped.

This brings us to the Act of the Llantrisant Gas Company. In the Bill the general purposes clause contained the words "by them," which had they continued would have limited, contrary to the decision of the Joint Committee, dealings in residual products to the Company's own production. The clause has been restored to the old form; and it is therefore now enacted that the Company may "provide, produce, sell, dispose of, and deal in gas, coke, tar, and all other residual products resulting from the manufacture of gas." But when we come to the construction and maintenance of works clause, we see that the words "by them" have been allowed to stay there; so that the end of the clause now reads: "May manufacture and convert all residual products resulting from the manufacture of gas by them." The only other change from the Bill is found in the reduction of the proposed standard price from 4s. 6d. to 4s. 4d. per 1000 cubic feet. The charge for gas for public lighting in the cases of the Llantrisant and Llantwit Fardre Rural District Council and to the Llantwit Fardre Parish Council is not at any time to exceed 4s. 3d. per 1000 cubic feet. The Great Western Railway and the Llantrisant and Llantwit Rural District Council have obtained protecting clauses. [*Parliamentary Agents: Messrs. Lees and Co.*]

From the Porthcawl and District Gas Act, the proposed electricity powers have been eliminated. No other changes from the terms of the Bill are met with until we come to the clause giving authorization as to the construction and maintenance of gas-works; and appended to the clause are the words: "Provided that no lands to the south of the existing gas-works shall be used by the Company for the manufacture of gas, and any gasholders erected on such lands shall not exceed 45 feet in height." The standard price has been reduced from the proposed 4s. 2d. to 4s. per 1000 cubic feet. In regard to the additional capital powers, although the electricity supply clauses have gone, the original stipulation that, in such an event, the additional capital should be reduced from £45,060 to £36,060 does not appear, so that the former sum stands. The standard quality of gas is to be on the calorific basis, in the terms mentioned on Jan. 7 last (p. 29). The Great Western Railway Company have obtained protective clauses; and so have the District Council. The latter have also got a purchase clause operative next session. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

In the Titchfield Gas Company's Act, the words "by them" have been removed from the general purposes clause, and adjustment made to the old open form of clause which allows free dealings in residuals; but, as in the case of the Llantrisant Act, the construction and maintenance of gas-works clause ends up with the words, "May manufacture and convert all residual products resulting from the manufacture of gas *by them*." The pity of it! There has been a little change in the capital. It is still £15,000. But instead of £5000 being equally divided between the original ordinary capital and the original preference capital, the moiety first allocated to the former has been reduced to £2100. The result is that the additional capital now stands at £10,400 instead of £10,000. With regard to the limits of supply, the powers of the Gosport Gas Company to supply in the parishes of Titchfield, Sarisbury, and Hook-with-Warsash are repealed; but it is provided that the repeal shall not take effect if the Gosport Company purchase the undertaking of the promoting Company. A special clause enables them to do this if, within two months of the passing of the Act, notice is given requiring the Titchfield Gas Company to sell—the terms of transfer being the payment of the sums of money actually expended upon the undertaking prior to the passing of the Act, and, in addition, £450 and the amount of the costs of the present Act. The period is limited within which the promoting Company are protected in relation to part of the extended area. It is provided that, if, after the expiration of five years from the passing of the Act, the Company have not laid down mains for the supply of gas throughout the parishes of Sarisbury, Hook-with-Warsash, or Curdridge, nothing is to prevent any company, person, or local authority having statutory power so to do from supplying gas in all or any of the parishes in which the Company are not either supplying gas or prepared to furnish a supply on demand; and, in this connection, the Company are not to oppose any application for an Act or Provisional Order for the purpose of providing such supply. In the Act are protecting clauses in favour of the South Hants Water Company, the Southampton County Council, and the London and South-Western Railway Company. There are no other important variations from our notice of the Bill last January. [*Parliamentary Agents: Messrs. Lees and Co.*]

The United District Gas Company have obtained the powers they sought for; and the Counties Gas Company will as such pass out of existence. The history of the concern was traced when noticing the Bill on Jan. 7. The objectionable words "by them" have been deleted from the general purposes clause; but, strange to say, they still appear as the concluding words of the construction and maintenance of works clause. In connection with the limits of supply, prohibition is placed upon the Banbury Gas Company not to supply gas within the parishes of West Adderbury, East Adderbury, Milton, and Bloxham so long as the United Company are supplying. There is a schedule to the Act providing for the supply of gas by the Banbury Company in bulk to the United Company for the supply of West and East Adderbury, Milton, Bloxham, Deddington, and any other parishes within the area of the United Company which the Company may supply from the West Adderbury works. The price to be paid for the bulk supply is to be 2s. 1d. per 1000 cubic feet for any quantity not exceeding 4 million cubic feet, and 2s. per 1000 cubic feet for any quantity exceeding 4 million cubic feet—provided that, if the Banbury Gas Company supply any other consumer at a less price than 2s., the 2s. 1d. and 2s. referred to above are to be reduced by the difference between 2s. and such less price. Protective clauses have been inserted at the instance of the Oxfordshire County Council, the London and North-Western Railway Company, the Great Western Railway Company, the Great Central Railway Company, and the Grand Junction Canal Company. In all other respects, the particulars given when noticing the Bill remain as then. [*Parliamentary Agents: Messrs. Lees and Co.*]

The foregoing are the only Acts by which gas companies sought incorporation and full statutory powers for the first time. We will now examine (in alphabetical order) some of the Acts resulting from the promotions of existing statutory concerns. Only the changes in the measures will be noted; and reference to other points can be made by turning back to the notices of the Bills in our issue for Jan. 14.

The Act of the Blyth and Cowpen Gas Company (which title is to be shortened to the Blyth Gas Company from the end of this year) confers the extension of area sought, and the acquisition of the Bedlington Gas Company on the terms set forth in our review of the Bill. In the Bill the promoters asked for the right to charge not exceeding 9d. per 1000 cubic feet extra in the extended area; but, applying to one part, the figure is now placed at 1s. But if, in this particular district, the consumption exceeds in any year 10 million cubic feet, the difference in price is to be reduced by 1d. per 1000 cubic feet in respect of each 1½ millions, or a fractional part of 1½ millions, in excess of the 10 millions. The Company, however, are to be under no obligation to charge less than 6d. in addition to the ordinary price that rules in the home area. In another part of the area, they are authorized to charge 1s. 9d. in excess of the ordinary price in the home area. A standard price of 4s. per 1000 cubic feet has been inserted in the measure. Protection is given to the Bedlingtonshire District Council, and among the clauses of the agreement is one making it obligatory on the Company to supply, lay, or fix new services and fittings on terms not less favourable to the consumers of gas within the urban district than to the consumers in Blyth. Discounts in the Bedlingtonshire urban district are also to be at the same rate, and subject to the same conditions, as to the gas consumers within Blyth. The North-Eastern Railway Company have also secured some protective clauses. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Bournemouth Gas and Water Company have obtained the powers sought regarding the purchase of the Christchurch Gas Company's property and the Wimborne Water Company's undertaking. The position of these two concerns and the terms of transfer were all of them set out in the review of the Bill on Jan. 14. There are no modifications calling for allusion in the rates and prices to be charged for gas in the extended area, save that it is provided that the maximum price to be paid by the Bournemouth Corporation for lighting purposes is in no case to be higher than the lowest price charged for gas supplied by the Company to any consumer for lighting purposes; but this provision is not to apply to gas supplied to the Corporation under an agreement dated Oct. 15, 1912. The additional capital authorization has been reduced from £200,000 to £150,000. In connection with the reduction of the illuminating power of the gas to 14 candles, the Company are, if required by any consumer, to supply and fix free of charge a sufficient number of flat-flame burners suitable for the consumption of gas of the prescribed illuminating power; this provision to be operative during two years. A stand-by clause in the Act refers only to a supply to persons having an independent gas supply for power purposes or a supply of electricity for power purposes; the minimum annual sum to be paid being such as will give the Company a reasonable return, not exceeding 7½ per cent. on the capital expenditure, and cover other standing charges incurred by them in order to meet the possible maximum demand for the premises. Protective clauses are inserted in favour of the Corporation tramways and the London and South-Western Railway Company. Apart from these particulars, there are no variations from the information given when

noticing the Bill that are worth alluding to here. [*Parliamentary Agents : Messrs. Crowders, Vizard, Oldham, and Co.*]

Henceforth to be known as the Crowborough District Gas and Electricity Company, the Act of this undertaking will enable a good extension of operations. The changes effected since we originally drew attention to the provisions of the Bill are very moderate in character. One is a reduction of the proposed standard price from 5s. to 4s. 6d. All the electricity powers sought have been obtained. The financial provisions remain as in the Bill; but separate capital and revenue accounts are to be kept for the gas and electricity undertakings. There are no other alterations in the proposals calling for attention here. [*Parliamentary Agents : Messrs. R. W. Cooper and Sons.*]

The Grays and Tilbury Gas Act authorizes the Company to purchase various gas undertakings operating on the borders of their old area, and to extend their limits of supply. The scheme includes the purchase of the Stanford-le-Hope Gas Company, Limited, the Laindon Gas Company, and the works of Mr. Worthington Church from which has been derived the supply to the parishes of Great Burstead, Rayleigh, Thundersley, Hadleigh, and Hockley. The details of the purchases were set out in the notice of the Bill as originally introduced. The Company are allowed five years within which to lay mains in the area as extended by the Act; and thereafter, if this has not been done, any company, person, or local authority may apply for statutory powers over the area without opposition by the Company, except upon details. The Act has been made voluminous by quite a number of companies and local authorities obtaining protective clauses. The Great Eastern Railway Company, the Midland Railway Company, the Southend Water-Works Company, the Essex Sewers Commissioners, the Essex County Council, the Billericay District Council, the Rochford Rural District Council, and the Chelmsford Rural District Council have all seen fit to obtain the insertion of clauses defining their rights and those of the Company in relation to certain matters. In the cases of the Essex County Council, the Rochford Rural Council, the Chelmsford Rural Council, and the Billericay District Council, it is provided, among much else, that where any work of the Company has been laid at a depth of less than 2 feet below the surface of any main road, the authority are not to be liable for any damage or injury caused to such work by the use by the authority of a steam or other roller or traction engine, provided that such roller or engine does not exceed 12 tons in weight. In the clauses for the protection of the Rochford District Council, there is one providing that, as soon as the Company have laid down mains connecting the existing works at Rayleigh with the Grays Thurrock works, and have commenced to supply gas through such mains for use in the district of the Council, or after the expiration of two years from the passing of the Act (whichever be the earlier date), the price to be charged by the Company for gas to the ordinary consumers in the district shall not exceed the price for the time being charged by the Company to ordinary consumers in the area added to the Company's limits of supply by the Act of 1907. The Company are also prohibited from laying down, without the consent of the Port of London Authority, any mains, pipes, or other works in the River Thames, or in any navigable creek or tributary of the Thames. It will be remembered that the Company relinquished part of the proposed new area during the progress of the Bill on account of opposition creating difficulties in regard to supply; and we miss from the Act the part of the proposal relating to the Ingatestone and Fryerning Gas Company, Limited. There are clauses confirming the agreements with the Stanford-le-Hope Gas Company, Limited, the Laindon Gas Company, and Mr. Worthington Church. The additional capital sought has been reduced by £30,000 to £120,000, with one-third borrowing power. Section 50 of the Company's Act of 1907—"Power to Supply Gas-Fittings, &c., for Heating and Other Purposes, and Fittings not to be Subject to Distress"—has been extended, and applies to dynamos, motors, and electric apparatus and fittings, and to petrol gas, acetylene gas, and other similar plants and fittings for using or producing gas. Power has been given to apply for an Order to authorize the supply of electrical energy. [*Parliamentary Agents: Messrs. Dyson and Co.*]

Masonic.

The regular meeting of the Evening Star Chapter, No. 1719, was held at the Freemasons' Hall, Great Queen Street, last Wednesday, when the principal chairs were occupied by Ex. Comp. Charles Meiklejohn, M.E.Z., Ex.Comp. J. W. Broadhead, H., and Ex.Comp. H. T. Adkins, J. The business before the Convocation consisted in the exaltation of Bro. Charles W. Braine, the Secretary of the Wandsworth and Putney Gas Company, Bro. Charles Hulme, the Engineer of the Uxbridge Gas Company, and Bro. F. L. Schofield, the Engineer of the Barnstaple Gas Company. The election of officers for the year 1914-15 was made; and Ex.Comp. W. A. Surridge, I.P.Z., was elected Treasurer of the Chapter.——We learn that W.Bro. F. E. Cooper, the Secretary of the Gas Companies' Protection Association, has recently had conferred upon him the distinction of "London Rank." Brother Cooper is P.M. of the Aldersgate Lodge No. 1675; Founder and P.M. of the Wantage Lodge No. 3178; P.Z. of the Aldersgate Chapter; Founder of the Anglo-Colonial Chapter No. 3175; S.O. of the St. Mark's Lodge No. 1; and J.D. of the Royal Ark Mariners Lodge No. 1.

A SERIOUS OMISSION.

QUITE recently there has been published by Messrs. Longmans, Green, and Co. a book entitled: "Heating Systems—Designs of Hot-Water and Steam-Heating Apparatus," by F. W. Raynes, Consulting Heating and Ventilating Engineer, and Lecturer on Heating and Ventilating at the Royal Technical College, Glasgow. The title suggested that here was a publication of interest to gas engineers; but on inquiry of the publishers we are informed that "it does not deal with gas at all." To our mind—and we think that all who are familiar with the capabilities of gas will agree—this is an extraordinary omission on the part of the author. It would be well were Mr. Raynes to spend a few days visiting some of the many heating installations fitted by any London or Provincial gas undertaking.

Presumably, the author intended to deal fully with the subject; for his book contains no less than 321 pages and is divided into 24 chapters. In the preface, he claims that "this work presents the most modern practice in an important branch of engineering." But we think that many who have experienced the convenience, efficiency, and cheapness of gas for heating and ventilating rooms will disagree with the author's claim.

We feel sure that the omission of gas will be a disappointment to readers who would naturally suppose that, in a book of this size, the whole subject would be fairly covered. As it is, many readers will have to turn aside from this work and apply to the gas suppliers. By the use of gas, and gas only, that ingenious and important device known as the thermostat may be used to control automatically the temperature of the water passing from the boiler. In this we have a labour-saving appliance that ensures absolute economy in gas consumption without effort on the part of the user.

We trust that the Glasgow Corporation gas officials will make a point of demonstrating to the author the extraordinary omission of which we complain.

LOCAL GOVERNMENT FINANCE.

Summary of the Taxation Returns.

WITH the issue of Part VII., the final volume has been reached of the Annual Local Taxation Returns for the year to March 31, 1911. This consists of a summary and index of the earlier volumes, particulars from which have at different times been given in the "JOURNAL" pages; and it brings to a close the forty-first annual series of returns compiled by the Local Government Board, respecting the accounts of the various local authorities of England and Wales.

The total number of the separate authorities coming within the definition set down for the purpose in the Local Taxation Returns Acts, 1860 and 1877, who had financial transactions during the year under review is 25,614—counting only once those of them who made separate returns respecting their transactions in different capacities. Particulars as to the sums received and expended by the Metropolitan Water Board are to be found in a separate parliamentary paper. As to the summary now noticed, the receipts quoted include the sums received by local authorities from Government grants towards expenses incurred in respect of elementary education, as well as the gross receipts from water, gas, electric lighting, tramways, and other undertakings carried on by them, and miscellaneous receipts from rents and sales of property and repayments on account of work done for private individuals. Money borrowed to meet capital expenditure is distinguished from other sums. The expenditure included is such as has been defrayed out of the receipts mentioned. The number of local authorities who had expenditure (other than that defrayed out of loans) during the year 1910-11 in respect of water supply was 1176, of gas supply 228, of electric light supply 249, and of tramways and light railways 171.

The total amount of public rates received in the year referred to was £65,152,299, of which 24 per cent. was collected in areas in the Administrative County of London. The receipts also included £21,164,998 from Exchequer grants (including local taxation duties), £25,818,070 from gas, water, electric light, and tramway and light railway undertakings, and £18,938,880 from other sources. At the commencement of the twelve months, the total of the gross value or gross estimated rental of the rateable hereditaments in England and Wales was £269,942,255; the total rateable value was £217,180,184; and the total assessable value for the Agricultural Rates Act was £205,314,046. Taking England and Wales as a whole, the gross value or gross estimated rental increased between the commencement of the year 1909-10 and that of 1910-11 by £2,997,359, or 1·1 per cent.; and the rateable value by £1,870,642, or 0·9 per cent. The average amount of public rates per pound of assessable value for the year 1910-11 was 6s. 4·16d., as against 6s. 2·62d. in the previous year, or an increase of 1·54d. Calculated on the estimated population, the amount per head was £1 16s. 5d., compared with £1 15s. 9d., or an increase of 8d.

The loans raised by local authorities in the year under review amounted to £18,225,822, which (excluding from the calculation the Port of London Authority) was smaller than the sum raised

the preceding year by £1,867,099, and less than the corresponding amount for any year since 1897-8. The amount of loans received during the year for gas-works was £382,959, as compared with £478,738 the preceding year; for water-works, £2,287,291, against £2,148,146; for electric lighting, £1,309,582, against £1,147,530. Besides these sums, there was an item of £2159 under the head of public lighting; but some of the borrowed moneys devoted to this purpose were entered against gas-works and electric lighting. The amount of loans outstanding increased during 1910-11 by £4,208,951; and this is smaller than any annual increase that has taken place since 1890-1. The total amount of outstanding loans at March 31, 1911 (including £49,701,816 for the Metropolitan Water Board), was £540,211,480; and the amount standing to the credit of sinking funds and other similar funds applicable towards the repayment of such part of this balance as was repayable by means of these funds was £21,595,096.

Further examining the £540,211,480 of outstanding loans at March 31, 1911, it is seen that the relative proportions in which this sum was distributed over the various purposes for which it had been borrowed are as follows: Baths, cemeteries, electric lighting, gas-works, harbours, docks, piers, canals and quays, markets, tramways and light railways, and water-works, £303,805,215, or 56·2 per cent. of the whole; elementary education, £41,370,651, or 7·7 per cent; highways, bridges and ferries, and sewerage and sewage disposal works, £101,824,821, or 18·8 per cent.; and other purposes, £93,210,793, or 17·3 per cent. If the amounts are further divided, it is found that £23,119,160 relates to gas-works; £128,687,495 to water-works; £29,681,430 to electric lighting; and £189,670 to public lighting. The average amount per pound of rateable value, over England and Wales, of the total loans outstanding is £1 8s. for undertakings which are revenue bearing, and £1 1s. 9d. for loans for all other works and purposes.

Excluding loans, the total receipts of the local authorities in 1910-11 amounted to £131,074,247. The following are some of the items: Gas-works, £7,804,558; water-works, £5,135,155; electric light undertakings, £4,023,381. The gross revenue of the gas undertakings carried on by local authorities, it is pointed out, rose from £7,530,347 in 1909-10 to £7,854,716 in 1910-11. In the case of electric lighting undertakings, the gross revenue increased from £3,697,543 to £4,060,682—sums received for power supplied to the authorities' own tramway undertakings not being included in these figures. The total receipts of local authorities from all sources other than public rates, Exchequer grants, and loans, amounted to £44,756,950. The total expenditure, excluding loans, was £129,416,957. Among the items may be mentioned: Gas-works: Maintenance and other expenses not being loan charges, £5,648,932; loan charges, apportioned as far as practicable, £1,548,198; total, £7,197,130, or 5·6 per cent. of the total expenditure. Electric lighting (other than public lighting): Maintenance and other expenses, £1,471,054; loan charges, £2,277,417; total, £3,748,471, or 2·9 per cent. Lighting streets, roads, &c.: Maintenance and other expenses, £2,268,975; loan charges, £22,033; total, £2,291,008, or 1·8 per cent. Water-works: Maintenance and other expenses, £1,908,980; loan charges, £3,682,206; total, £5,591,186, or 4·3 per cent.

TAR PRODUCTS AS AUTOMOBILE FUELS.

THE two communications presented to members of the Institution of Automobile Engineers in the current session have both dealt with the fuel question, and benzol has received special attention from the authors of both communications.

First, Mr. J. S. Critchley, in his Presidential Address to the Institution, discussed the available supplies of benzol in this country; and the figures given by him have already been reproduced in the "JOURNAL" [*ante*, p. 142]. He also pointed out that in actual practice benzol had been proved to give an increase in mileage of about 20 per cent., and in power of from 12 to 15 per cent., as compared with petrol. The second communication was one presented on Wednesday last by Dr. W. R. Ormandy, on "Some Experiments on Mixed Fuels, with Special Reference to Alcohol Mixtures." As a fact, the mixtures tried by Dr. Ormandy were entirely mixtures of alcohol with varying proportions of benzol; so that his paper also is instructive to those who are interested in the production and sale of benzol. Some notes from Dr. Ormandy's paper are given on p. 580 of to-day's issue.

Reading between the lines of Dr. Ormandy's paper, it is obvious that, for the present, alcohol can be regarded as a practicable motor fuel only in so far as it may serve as a diluent or vehicle for a richer fuel (of which benzol is the best) which is commercially available. Thus we learn from Dr. Ormandy that his experiments led to the conclusion that progress in the direction of using alcohol virtually as the sole fuel for automobiles must be sought through experimental work upon mixtures containing gradually diminishing amounts of benzol. Ultimately, he thinks that it may be found possible to eliminate all but that very small percentage of benzol which is desirable on excise grounds, as well as to assist starting. The influence of benzol is, according to Dr. Ormandy, out of all proportion greater than the small quantity employed. A half-and-half mixture of benzol and alcohol is, generally speaking, as good as ordinary petrol; but when the benzol is reduced to one-third of the mixture, much greater difficulties arise in its use.

The use of benzol as an automobile fuel which is superior to petrol is now well established; and evidently consumers will readily absorb all the benzol which can be produced and sold at the same price per gallon as petrol, or even, having regard to its higher efficiency, at a slightly higher price. Some of the speakers in the discussion on Dr. Ormandy's paper seemed to think that the purveyors of benzol were treating them harshly because they refused to sell benzol at a lower price than petrol. Actually, the benzol put upon the market as an automobile fuel has already had a marked effect in retarding the upward tendency in the price of petrol. Having regard to this beneficent influence, it seems unreasonable that motor-car users should carp at the vendors of benzol, because they abstain from selling their material for less than it is worth.

As to alcohol as a competitor with petrol and benzol as a motor-car fuel, there appears no prospect of any considerable quantity of alcohol becoming available for the purpose in this country. Modern methods of producing alcohol for industrial requirements would admit of its importation in bulk into this country at a price of about 1s. a gallon, if the excise and customs regulations in regard to methylation and importation were modified in the most favourable sense. That is to say, alcohol might be imported or produced in this country for about the same price as benzol now fetches in bulk. The distributing charges would not be less in the case of alcohol, so that it would appear as if the automobile user in this country is unlikely to obtain alcohol at a lower price than benzol. Clearly, therefore, he will prefer the latter fuel, which has a calorific power of over 160,000 B.Th.U. per gallon, as compared with only 94,540 B.Th.U. for methylated alcohol. The scope for employing methylated alcohol as a motor fuel in competition with benzol in this country seems to be extremely restricted, especially as, unlike benzol, it cannot be used without substantial modification of the carburettors that are designed for petrol.

GLOVER-WEST VERTICALS AT CAMBUSLANG.

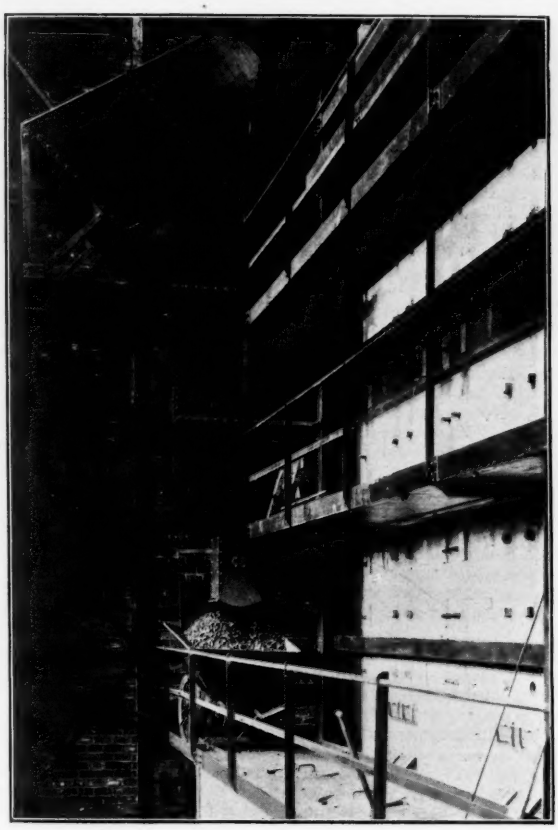
Visit of the Scottish Junior Gas Association (Western District.)

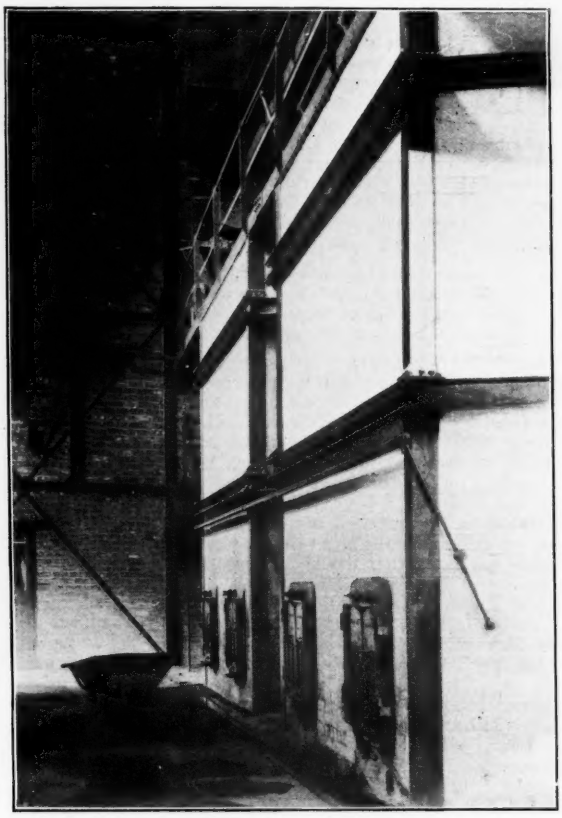
To the number of about sixty, members of the Scottish Junior Gas Association (Western District) visited the Cambuslang Gas-Works on Saturday, for the purpose of inspecting the recent installation of Glover-West vertical retorts—a couple of views of which appear on the opposite page.

The visitors were received by the Chairman of the Gas Company (Mr. David Rankine, J.P.), who, in extending a hearty welcome, said the works were an old institution, having been inaugurated somewhere over forty years ago, when the place was only a little hamlet of from 3000 to 5000 inhabitants. It had now grown to a population of 20,000 in the immediate neighbourhood. If they had had to select the position of the works, they would not have planned them where they were; but they now had to adapt themselves to the site. The real difficulty about the works was the lack of railway accommodation. This had been looked into; and no doubt within a few years a siding would be provided. Their policy had been, when there was a demand for gas, to lay the pipes to the places from which the demand came, irrespective of whether immediate profit would be derived from doing so. Like many others, they had also, during the last few years, to face the competition of electric light, which in their instance was supplied by the County Council. They had had competition with Glasgow, whose pipes were for some distance laid alongside the Cambuslang pipes; but they had come to a satisfactory arrangement with Glasgow to keep within a certain radius.

Mr. Thomas Carmichael (Dalmarnoch), Vice-President of the Association, replied on behalf of the visitors, thanking the Company for the privilege of seeing over the works.

Mr. Robert Simpson (the Manager) showed the party round, and they displayed every interest in the smooth working of the new vertical retorts. The Glover-West system has proved supremely successful in its adaptation to Cambuslang. They started working in July 2 with four retorts, making about 130,000 cubic feet of gas per day—the amount required at the time. At the present moment, they are working twelve retorts, with an output of 360,000 cubic feet and the capability of doing a little more. There is still a reserve of four retorts, making sixteen in all. The old bench, too, is in good order, so that the horizontals can be used to supplement the work of the verticals if the demand goes above 500,000 cubic feet per day—the make of which the latter are capable. Mr. Simpson has found the new system as easily handled as any horizontal bench, either in heats or in manipulation of the coal. It takes considerably fewer men to operate it. He is working at present with three stokers for the whole bench, as against the fourteen necessary with the old horizontals; and 30,000 cubic feet per day more is being made with the three men. The total cost of the installation works out at £9500. The coke has proved much superior to what it was with the horizontal bench, and is readily bought up. The yield of bye-products has also increased. The gas is of even quality, at 16-candle power. The cost is 2s. 9d. per 1000 cubic feet, less percentages, according to the amount used.





THE GLOVER-WEST VERTICAL RETORT-SETTINGS AT THE CAMBUSLANG GAS-WORKS.

IMPROVING THE YIELD OF LIQUID PRODUCTS.

By "Works Engineer."

Having discussed at some length the question of make of coke for sale, the two remaining important residuals, tar and ammonia, will be considered. In the first article on coke, it was shown that the coke produced for sale per ton of coal was often worth more than the gas made from the same ton of coal—taking, of course, works costs as the basis for valuing the gas. This comparison emphasized the value of coke to the gas undertaking and the importance of making as much of it, and using as little, as possible.

In the recently published "Gas World Analyses of Gas Companies' Accounts" for 1912, it is noticed that, of those included, 21 undertakings did not make carburetted water gas during the year; so that, to obtain an idea of the importance of the liquid products, it will be fair to give the average figures of these companies:

Receipts from Residual Products per 1000 Cubic Feet.

Coke. d.		Tar. d.		Ammonia. d.
7·87	..	2·07	..	2·53
		4·60		

Presumably receipts from the sale of breeze are included with those of coke, as no separate heading is provided. In any case, the value of breeze is very small in proportion to that of coke; so that it will affect the comparison but slightly. Besides, it has in any case some right to be included; for what is it but small coke and coke dust and half burnt coke? Here it is seen that the receipts from the two liquid products together amount to about 37 per cent. of the total yield from residuals; so that they have an important bearing on the cost at which gas can be made.

Tar.

It is a curious fact that large works do not, as a general rule, produce so much tar per ton of coal as the smaller ones. This is probably due to the fact that the former usually work their retorts at a higher heat. If this is not the reason, the writer can suggest no other. Of the 21 companies who limited their make to coal gas, three made over 1000 million cubic feet per annum; while the remainder made less than 500 millions. The average production in the case of the former was 9·7 gallons per ton of coal; while in the case of the latter, it was 11·5 gallons. If, again, the 18 companies are split up into two divisions—those making over 250 millions and those making under 250 millions—it is noticed that the larger companies made an average quantity of 11 gallons of tar; while the smaller ones made 11·7 gallons.

While high heats are undoubtedly a factor in limiting the production of tar, yet it would be thought, from a theoretical standpoint, that carbonization in heavy charges, such as are used by the three large companies already mentioned, would have increased the yield of tar over that obtained in small charges, such as are more generally used in smaller works. Curiously enough, this does not appear to be the case in practical working, if figures are a true criterion of what does happen. There are two directions in which tar may be lost. One is by leakage, especially from underground tanks, and the other is in the important piece of plant between the retort and the top of the bridge-pipe. The former source of loss has always been existent; but the latter has been much increased, in the writer's opinion, in those works in which heavy charges have come into vogue.

To catch the tar, it is necessary for it to reach the top of the bridge-pipe as a vapour. Should it condense before it reaches this point the tar will be lost. It must reach a part of the bridge-pipe from which, should it condense, it will flow into the hydraulic main. This is the crucial point. Should it, however, condense on the wrong side of the bridge-pipe or in the ascension pipe, it will flow down the pipe on to the mouthpiece, or it may lodge in the ascension pipe and be slowly converted into pitch, and cause a stoppage. With heavy charges, it will probably flow down to the mouthpiece, owing to the comparatively low temperature in the ascension pipe. Here it will burn so soon as the retort is opened, or it may go to swell the breeze made per ton of coal. Anyhow, it is lost as tar. In working heavy charges, black ends and tarry mouthpieces are too often noticeable. With this method of working, really hot mouthpieces—that is, the fire-clay mouthpieces of the retorts—are a *sine quâ non* of good work; and yet nothing is more difficult to obtain. Unless the mouthpieces are hot, it is useless to expect to carbonize so large a bulk of coal as must lie at the end of a charge of (say) 12 inches in depth. A good method of keeping the mouthpieces sufficiently hot was explained in Mr. Gill's paper on "Retort-House Furnace Charging and Other Details," read at the Southern District Gas Association meeting held in November, 1912.

Unless the mouthpiece is hot enough, and the charge is properly sloped off at the end, the space inside the iron mouthpiece will be virtually a condensing chamber. Under the best conditions it is bad enough; but under the worst, it will most assuredly result in serious loss of tar. The gas, in passing from the retort into the ascension pipe, will probably drop some tar on the iron mouthpiece; but let it drop as little as possible. The tar vapour has then to run the gauntlet of the ascension pipe. Should this be large or long, the conditions are bad for losing tar. The object should be to rush the gas from the retort into the hydraulic main as quickly as possible, so that it may reach that point in a sufficiently heated condition to have preserved itself as a vapour. A large ascension pipe and a high one is merely like a condensing

chamber to catch the tar, and is, besides, unnecessary with heavy charges. With six-hour charges, an excellent method to cure stopped pipes is to lengthen the ascension pipes, and so cause a certain amount of the tar to condense in the pipe. Thence, flowing down, it keeps the pipe cool, and prevents the formation of pitchy deposits. Every stoker knows that a moist ascension pipe is always clear.

With heavy charges, the gas, together with the tar vapour, is cool enough when it enters the ascension pipe not to cause stoppages; and by the time it reaches the top of the ascension pipe, it is often too cool to have retained the tar vapour. Therefore, it is important, if a good make of tar is to be obtained, to:

1.—Slope the charge at the end.
2.—Keep the mouthpiece as hot as possible.
3.—Avoid the use of large ascension pipes.
4.—Keep the ascension pipe as short as possible.

These rules only apply to works where heavy charges are used. The first two rules will also improve the make per ton.

Another method recommended to the writer, but so far not adopted, is to fit iron mouthpieces to the retorts at a slightly upturned angle, so that tar, when condensed in the mouthpiece, drains towards the retort, and is by this means gasified or revaporized by the hot retort or the coke at the end of the charge. He was told that a ¼-inch fall from the front to the back of the mouthpiece was sufficient, and, further, that this slope did not in any way detrimentally affect the easy discharge of the coke. The writer suggested that the slight upward gradient in the mouthpiece might cause a breaking-up of the charge at this point on its removal, but he was told that it did not affect it at all.

Theoretically, it is quite certain that coal carbonized in bulk should produce more tar than that carbonized in a thin layer; and the writer believes that this theory will be endorsed in practical working if due consideration be given to the conditions existing at the retort mouthpiece and ascension pipe. In his own case, the tar made has increased from about 9½ to 10½ gallons per ton of coal since due attention was given to this point; and he has reason to believe still further improvement may be expected.

WORKS TOPICS.—VII.

By "Modus Operandi."

In these days of high oil prices, the excessive cost of making carburetted water gas, as compared with the corresponding cost of making coal gas, is serious enough to cause us all to cogitate much on possible economies. Few engineers will go so far as to shut down the entire water-gas plant, even if oil is very high in price. It is too drastic a step from so many points of view. There is the coke market to consider, the effect on consumers' fittings, and smaller reasons, such as the finding of work for the water-gas men, and increase of naphthalene and sulphur in the gas. Again, the coal-gas plant may not be large enough to deal with the whole output. Every engineer should consider well whether there are not possibilities of economizing in the cost of making water gas. It may be neither feasible nor politic to spend money immediately on alterations to plant that may only be used partially for some time to come. At the same time, the subject should not be dismissed until oil falls again to a reasonable price, as then the plant will be required for gas making, and not for alterations.

There are several directions in which there exists room for improvement. They may be conveniently tabulated as follows:

1.—Replacement of the Lowe generator by one of the Dellwik or Kramer and Aarts type, to obtain:
   (*a*) More water gas per ton of coke;
   (*b*) Larger make per square foot of grate area;
   (*c*) Better quality of gas containing less carbon dioxide.
2.—The use of steam and air meters, pyrometers, automatic clocks, and cycle recorders, thereby gaining higher efficiency.
3.—The use of steam superheaters to enable more gas of good quality to be made per ton of coke.
4.—The paying of more attention to the efficiency of the oil spray and the state of the carburettor.
5.—The use of best coke only—that produced from the highest quality of coal being stored for this purpose.
6.—The fitting of automatic stoking grates to the boilers, thus enabling one man to look after both boilers and engines.
7.—The conveyance of coke from the retort-house to the water-gas plant in the cheapest possible manner.
8.—The adaptation of a better form of grate to the generator, such as the Kerpely, or, failing that, a stepped grate.

Most of the foregoing suggestions would involve the expenditure of a good sum of money. At the same time they are all money-savers, and would probably prove good investments.

To deal briefly with these points in order:

1.—The Lowe type of generator is defective, in that it passes forward to the carburettor and superheater far more combustible gas (carbon monoxide) during the "blow" than is required for heating these vessels. The waste gas (carbon dioxide) alone passing from the generator would probably be sufficient to maintain the two later vessels at the required heat. This loss is inevitable with the Lowe type of generator, owing to the depth of fuel required for the run. As a consequence, a wasteful quantity of coke is consumed during the blow. The other types of generators correct this fault, and are thereby enabled to produce a higher make of gas per ton of coke, and, incidentally, more gas per square foot of grate area, owing to the fact that the complete combustion of the air and carbon to carbon dioxide causes the coke to be raised very quickly to a high heat. The same reason enables a better quality of gas to be made.

2.—Not nearly enough use is made of scientific instruments; too much is left to the gas maker's judgment. With the help of good instruments, a gas maker can work his plant to much greater advantage. Exact regulation of temperature, the right quantity of steam and air, and the certainty that the blows and runs are started and stopped accurately are points of the greatest importance.

3.—It is, too, an advantage to use dry steam. This is obviously the case, for the passage of steam through red-hot coke has such a great cooling effect that it is distinctly beneficial to pass the steam through in as dry a state as possible. By the use of steam superheaters this advantage is obtained, with the result that a greater volume of superheated steam can be used per run than in cases where ordinary steam is employed. Or, similarly, the same amount of steam can be used per run, which procedure will result in the making of a better quality of gas containing less carbon dioxide.

4.—The oil spray is of very great importance, especially in times of high oil prices, as it is then that the effect of a bad spray is so much magnified. It is the cost of oil at present prices that accounts for something like 75 per cent. of the total cost of making carburetted water gas; so that it is imperative that the spray in use should spread the oil equally over the area of the carburettor in a finely atomized state. The design of the spray, and its maintenance in a clean condition, the regular replacement of the checker work in the carburettor, and the pumping in of the oil at the correct pressure, are all specially important matters when oil is high in price.

5.—The importance of using the best coke only, particularly since a ton of coke will make 50,000 cubic feet of gas, is very evident in every-day working, for the use of a good coke will enable a plant to turn out quite 10 per cent. more gas than at times when bad coke is employed. The extra cost of storing 20 tons of coke per million cubic feet made is infinitesimal compared with the immense advantage obtained. Besides, should a high quality of coke only be used, it is possible in some cases to double the clinkering periods and save half the cost of this item of expenditure.

6.—In many water-gas plants the cost of attending to the engines driving the exhauster and blast fan and oil and steam pumps is quite disproportionate to the amount of work involved. In such cases, it should be possible to reduce the boiler work sufficiently, by installing automatic stokers, to enable one man to do this work and attend to the engines as well, besides taking his part in clinkering operations. In such cases, the fixing of automatic feed-water regulators would be advantageous.

7.—This is obvious enough, though often disregarded.

8.—A better type of grate is badly needed. The removal of clinker is the chief item of expense, so far as labour is concerned; and, besides, the interference with gas-making operations while clinkering is proceeding, and the reduction in efficiency when clinker has formed, are sufficient reasons for emphasizing this requirement.

The advantage of such improvements would be very great; but, even so, were the cost of labour reduced by one-half, and the duty per ton of coke increased by 30 or 40 per cent., the expense of making carburetted water gas would still be much higher than the cost of coal-gas. Not until 1½ gallons of oil will give as high a duty as 2½ gallons do now will carburetted water gas compete on equal terms with coal-gas. This desideratum will, however, only be attained—if ever—by not only improving the methods of cracking oil, but by so altering the generator and system of working as to result in the manufacture of a very high quality of blue gas with which to mix the oil gas. The oil gas must be diluted; but let it be diluted with the highest quality of blue gas that can be made.

Gas for Heating Water for Public Baths.—The October "Bulletin" of the Belgian Gas Association contains a paper presented at one of the meetings by M. Raoul Frère, of Paris, in which he described a system of applying gas for heating the water for public baths. The problem to be solved was to have a constant reserve of water, so that during the quiet hours of the day the service could be assured, and also be equal to meeting, when required, the heavier demands at the busy time. The work was carried out by the Société Chaleur et Lumière, who put in a boiler of small size and a series of tanks which could be quickly connected with it, together with the necessary arrangements described in the paper for regulating the combustion. The advantage claimed for the system is that, thanks to the facility afforded by heating by gas, the cost of fuel can be reduced to a minimum during the hours of low output; whereas in the case of solid fuel the consumption cannot be lowered beyond a certain point. The boilers employed in the system vary in size; and some tests carried out showed their average daily consumption of gas to be 565 cubic feet to produce 10,000 calories, and proportionate quantities for larger sizes.

A GERMAN APPRECIATION OF THE NATIONAL GAS EXHIBITION.

THE number of the "Journal für Gasbeleuchtung" for Nov. 15 contains an appreciation from the German point of view of the gas exhibition held recently at Shepherd's Bush, of which the following is an abstract: The foreign visitor to the exhibition, the British Commercial Gas Association meeting, and the Imperial and International Day at Shepherd's Bush was impressed by the great esteem in which the gas industry is held by all classes in England, just as the consumption in England is comparatively so much larger than in Germany; and this was evidenced by the list of eminent names on the roll of Patrons, headed by the King and Queen, a royal Princess, and famous men in the Church, Nobility, and Army. Most impressive also were the solemn reception in the Guildhall by the Lord Mayor, with all its civic pomp and ceremony, and the meeting of the Association and the annual dinner in such historic surroundings. This impression of the important position of the industry was further strengthened by the extraordinary number of people who visited the exhibition, and who so obviously enjoyed themselves to the full. The impression was given that the visitors really looked on gas as a good and trusted friend, and that they came to see what new things it could offer them beyond what they already possessed. Among the visitors, too, there seemed to be far more who understood something about gas than is customary in Germany—no doubt a result of the more energetic educational work of the English gas companies, and especially of their splendid show-rooms. The fact that, in spite of the superior acquaintance with gas of the average Englishman, an exhibition of this kind could attract such large and grateful numbers of the public is surely a lesson on the importance of holding educational exhibitions regularly. At Shepherd's Bush there was evidence everywhere of the intention of following the motto of the British Commercial Gas Association, "all for one and one for all," and, by general co-operation of all concerned, to give the visitor a really educative general picture. This is further evidenced by the amount of the guarantee fund.

Without dwelling on many of the details, the author emphasizes the importance and success of the demonstrations of the industrial uses of gas. Of special interest to German gas men was also the fact that, in the whole show, only one small reflector fire was to be seen, and that hidden away in an insignificant position. The large number of pillar-fuel fires aroused keen interest, and the writer was surprised to hear that there are provincial gas concerns which are giving out as many as 200 weekly. He hopes that their adoption in Germany will increase in the near future, for the diversity of conditions in the two countries is not great, and experiments over there have shown that these English fires will do all that is claimed for them. It is to be hoped and expected that many of them will be on view at the big exhibition in Munich next year. The writer was much impressed by the popularity of the cookery demonstrations and competitions which were a daily feature of the exhibition, in spite of the already widespread application of gas to cooking in England. And the holding besides these of 27 other popular lectures during the month was still further evidence of the interest of the public in gas, and its thirst for knowledge of it.

Munich Gas Exhibition, 1914.

From the "Journal für Gasbeleuchtung" for Nov. 15 we learn that His Majesty King Ludwig III. of Bavaria has graciously consented to become a patron of the German Exhibition, "Gas, its Production and its Use in Public, in Home, and in Industry," which is to be held next year in Munich. This great honour, continues the German journal, one of the first of his public actions as King, is a hopeful sign that the exhibition will in fact be, as planned, the most brilliant undertaking up to the present of the German industry. It is yet another call to all branches of the industry to help.

New Automatic Gas Extinguisher.

The October number of "Le Mois Scientifique et Industriel" draws attention to a new device for automatically extinguishing gas-burners at a predetermined hour, described by Dr. Robert Bass in the French publication "Les Nouveautés Chimiques pour 1913." The apparatus consists in a short length of gas-pipe, which is securely fixed by means of clamps to the back of an ordinary alarum clock. In the pipe there is a tap, which is so hollowed out and shaped that it fits on to the wind-key of the alarum. The pipe is then introduced into the gas system, with the tap open. The alarum is set to the hour when it is required to turn off the gas. When the alarum starts, the key turns, and at the same time twists the tap of the gas-pipe and shuts off the supply. The whole device is extremely simple, and should prove useful for laboratory work, &c.

Mr. Thomas Bickley, one of the Directors of the Staffordshire Potteries Water-Works Company, left estate of the gross value of £29,383.

MANCHESTER JUNIOR GAS ASSOCIATION.

University Lecture.

In continuation of the movement originated by the Manchester and District Junior Gas Association, and supported by the Manchester District Institution of Gas Engineers, for promoting scientific work in the University of Manchester by those interested in the gas industry, the second lecture of the session was delivered on Saturday afternoon in the Physics Theatre by Mr. H. JAMES YATES, F.C.S., M.Inst.M.E. There was a very good attendance—a fact which indicated that the subject was not only recognized as an interesting one, but that it is of value and importance to the members of both Senior and Junior Associations, as well as to gas apparatus manufacturers generally. A number of trading firms' representatives interested in research work were present. The chair was occupied by Mr. SAMUEL TAGG, of Preston, who was supported by the President of the Association (Mr. W. L. Heald, of Preston), Mr. J. M'Nicholl (the Junior Vice-President), and other members of the Council.

Mr. TAGG, who was very cordially applauded on rising to open the proceedings, said he had much pleasure in being present at one of the most useful functions of a most useful Association. It was not necessary for him to say anything to them on matters dealing with progress in the scientific construction of gas-fires, nor was there any need for him to introduce the lecturer, who was well known to most of them. Everyone associated with the gas industry appreciated the assistance which the development in gas-fire construction had already rendered to the profession. The present type of fire, he thought he might venture to say, was really not more than five years old. It had not only effaced many of the objections formed by the use of the old type of fire, but had won its way on its own merits. The success of the gas-fire had been remarkable when one considered the short time it had been before the public. Anyone connected with the sale of fires must have realized the great future of gas heating, particularly those undertakings supplying gas at a cheap rate. At Preston, they had fixed about 2000 fires. It was, perhaps, a difficult matter to put an estimate upon the consumption derived, but it certainly was not less than 20 million cubic feet per year. For this he thought that the gas industry was almost entirely indebted to the gas-fire manufacturers. The whole of the ability and scientific knowledge at the command of manufacturers had been directed to the development of the modern gas-fire—the result being that the whole of the industry benefited. Sometimes, however, they of the gas profession did not properly recognize, or acknowledge, their indebtedness to the gas apparatus manufacturers. Their Association, at any rate, heartily appreciated the courtesy and hospitality extended on their visit to Birmingham, as well as to other large manufacturers who had contributed to the development of the gas industry.

Mr. YATES then delivered his lecture entitled "A Survey of the Gas-Fire Position," which appears on p. 581.

REPLIES TO QUESTIONS.

The PRESIDENT announced, at the conclusion of the lecture, that the Council had decided not to permit anything in the nature of a discussion; but the lecturer would answer any questions.

Mr. YATES then dealt with a number of interesting points raised by questioners, covering a wide range of subjects.

At the conclusion,

The CHAIRMAN said the members had put Mr. Yates through a rather severe cross-examination. They had sent up a fusillade of questions, the answers to which had elucidated many of the problems connected with gas-fires. Accompanying the advance in the designing of gas-fires there had undoubtedly been an advance in scientific construction of the casing.

The PRESIDENT, in moving that the best thanks of the members be accorded to Mr. Yates for his lecture, said that, judging by the volume of questions asked and answered, they had had a most successful meeting. Not only had they to thank Mr. Yates for his lecture—this was one of the smaller things they had to thank him for—but they had to recognize the immense amount of good which he and the firm of which he was so distinguished a member had rendered to the gas industry generally. He need hardly say that Mr. Yates was one of the principal members of the firm of John Wright and Co., and was, he believed, one of the pioneers of vertical gas-fire fuel—the fuel which had enabled gas engineers to deal with many heating problems. The industry was certainly making great progress with gas-fires, especially in regard to efficiency. Undertakings throughout the country had benefited by the enterprise of gas apparatus manufacturers. He wished that some of the lighting authorities in the country would take a leaf out of the book of the gas-fire makers, for by this means the use of incandescent burners would be further popularized. He was conscious of the fact that the profession owed a great deal to the enterprise of trading concerns, and assured Mr. Yates that the members heartily appreciated the visit they paid to Birmingham some time ago.

Mr. J. TAYLOR (Mossley), in seconding, said that the lecture had been delivered at a most opportune time, as the question of gas-fire efficiency had aroused a vast amount of contention in the industry. Dealing with the present type of gas-fire, the speaker went on to say that the new patterns had been wonderfully successful. Had it not been recently stated that in London alone

no less than 2 million coal-fires had been displaced, and that the fog-fiend was being driven from his stronghold? He thought that the industry generally ought to be proud of the services thus rendered to the community, apart from any benefits accruing to themselves. Mr. Yates had undoubtedly rendered very valuable services to the profession—indeed, he might almost say he was unrivalled in the work which he and the firm of John Wright and Co. had done in this respect. The public work of Mr. Yates was known to all of them. He could not do better than refer to his labours as Chairman of the Society of British Gas Industries, and his work as a Vice-President of the British Commercial Gas Association, as well as to the duties Mr. Yates performed in connection with the recent exhibition. For all this splendid work they, as engineers, could not hold him in too high regard, and must acknowledge, in the most cordial manner, their thanks for the excellent lecture he had given.

Professor HAROLD B. DIXON, who was received with enthusiasm in acknowledgment of the distinguished honour accorded to him last week, said he only proposed to say "two words." The first was with regard to vertical fuel. He thought that Mr. Yates was really the first advocate of this system, and in his lecture he had explained this particular form of radiant. They all recognized the eminent services rendered to the profession by the lecturer, and he, as an honorary member, thanked him most heartily for his contribution. Everyone in the room that afternoon must have felt that Mr. Yates had not come there simply to advocate one particular form of gas-fire, or to say that his was better than that of anyone else. He had approached the subject of scientific gas-fire construction in a very modest and non-assertive way; and their thanks were due to him for the manner in which he had handled a difficult subject. He had much pleasure in cordially supporting the vote of thanks.

Mr. YATES, replying, thanked the members for the kind reception they had extended to him. He assured them that his investigations would continue, and that he would make public the results of future work for the benefit of everybody concerned. It was to the interest of all connected with gas-apparatus construction to turn out the best possible article. All managers worked on this principle. If he, for instance, turned out a bad article and other firms turned out a good one, it was the bad one which injured the development of gas heating, and retarded the progress of the profession. For his own part, he said "Let the best man have the most trade."

THANKS TO THE CHAIRMAN.

Mr. J. W. NICHOL (Radcliffe) said he was sure he voiced the sentiments of every member of the Association when he stated how delighted they were to see Mr. Tagg there that afternoon. They hoped it would not be the last time he would grace their proceedings. It was not for him (the speaker) to enlarge upon Mr. Tagg's capabilities; but at any rate they could thank him for the great interest he had ever taken in their doings—for instance, his scheme of encouraging the members to write essays dealing with points of interest connected with their visits to different works. He hoped that Mr. Tagg's efforts would be rewarded by a large number of papers being sent in for adjudication.

Mr. FRANKLIN THORP (Manchester) seconded, and alluded to Mr. Tagg's brilliant work for the profession. He also voiced the congratulations of members to Professor Dixon on the honour so worthily bestowed upon him.

The CHAIRMAN briefly responded, and the afternoon proceedings terminated at a rather late hour.

In the evening, there was an informal discussion by some of the members on "Gas-Fires: Fixing and Maintenance;" the subject being introduced by Mr. A. M. Taylor, the Outdoor Superintendent of the Stretford Gas-Works.

MIXED FUELS FOR MOTOR DRIVING.

The Value of Alcohol and Benzol,

The Institution of Automobile Engineers have had before them a paper by Dr. W. R. ORMANDY, in which he gave a detailed account of some experiments to determine the value of certain fuels for driving motors, with more especial reference to alcohol mixtures. The following is an epitome of the paper.

About ten years ago, the author spent considerable time on the Continent inquiring into the conditions existing there with respect to the manufacture and utilization of industrial alcohol; and he subsequently urged the necessity for the continuation of the work which had been done in Germany in the direction of employing spirit as a motor fuel. Nothing, however, was done in the matter. The ever-growing price of this fuel has again drawn public attention to the subject; and the author, who is associated with "The Autocar," accepted a proposal emanating from that publication to carry out a number of experiments on motor fuels, particularly with mixtures of which alcohol forms a constituent. He believes that alcohol is the fuel which will pay best, soonest, and longest for investigation. It is the only one that can be relied upon for quantity, permanency, and acceptability of price; but wherever the subject of its use as a possible motor fuel is discussed, its low heat-giving value is emphasized. The reply is that this is compensated for, if not actually outweighed, by certain other properties which are manifest when it is used intelligently in an internal-combustion engine. In discussing the general line along which the experiments should proceed, Dr. Ormandy came to the conclusion that the development of what might be called an essentially alcohol engine lay through the utilization of a mixture of alcohol and benzol.

Before describing the actual results obtained, the author gives a table of the principal ingredients in ordinary petrol, commercial benzol, and methylated spirit, and it shows how poor alcohol is in heat value compared with petrol and benzol. If the worth of a fuel were gauged on its heat-giving power, there would be no question as to the impossibility of using alcohol, unless it were obtainable at something like half the price of its competitors. The author's experiments, however, show that this is by no means the case. The point of interest is not the heat value of the fuel employed, so much as the total of it which can be returned in the form of work. The actual composition of the mixture of fuel and air which will give the best results in the cylinder can be calculated with great accuracy by well-known means. The author gives an example in which benzol is worked out, and it shows that one volume of benzene vapour requires 38·5 volumes of air so as to form a perfect explosive mixture, and that this results in 39 volumes of combustible products. Other tabulated results led Dr. Ormandy to the conclusion that there is no theoretical difficulty in getting into the cylinder of any engine an equal amount of potential energy in the form of a perfect gas mixture with any of the fuels under consideration.

The author then gives a description of the arrangement employed by Messrs. Craig and Napier to carry out the experiments. The engine was a Maudslay standard four-cylinder one of 90 mm. bore and 130 mm. stroke, having a compression space in the respective cylinders of 24·1, 24·9, 24·2, and 24·2 per cent. of the volume swept, *plus* the clearance. The fuels employed in the tests were petrol, 90 per cent. benzol, 50-90 per cent. benzol, and methylated spirit; their respective specific gravities being ·710, ·885, ·875, and ·815 at 60° Fahr. The following brake-horse-power and consumption tests were made: (1) Petrol only; (2) 50-90 per cent. benzol; (3) 90 per cent. benzol; (4) mixture of 50 and 50-90 per cent. benzol and 50 per cent. methylated spirit; (5) mixture of 33·3 per cent. of benzol and 66·6 per cent. of methylated spirit; (6) mixture of 25 per cent. of 50-90 per cent. benzol and 75 per cent. of methylated spirit.

Preliminary tests showed that on none of the mixtures of methylated spirit and benzol did the engine run steadily under load, unless the temperature of the jacket of the induction-pipe was at least 160° Fahr. It was found that the benzol took less air than the petrol, and that the more methylated spirit there was in the mixture the smaller was the quantity of air required. The engine ran at about 300 revolutions per minute with all the mixtures, and was quite easily started from the temperature of the test-room, which was kept about 70° Fahr. From the figures obtained, it was found that the engine running at 1000 revolutions per minute, gave 1·25 per cent. less power and used 15·5 per cent. less benzol than when running on petrol; gave 1 per cent. less power and used 3·7 per cent. less of the 50 per cent. benzol-methylated spirit than when running on petrol; gave 8 per cent. less power and used 8·9 per cent. more of the 33·3 per cent. mixture than when running on petrol; and gave 8·5 per cent. less power and used 24·5 per cent. more of the 25 per cent. mixture than when it was running on petrol. These percentages all represent volume. Benzol and methylated spirit mixed readily; and they showed no tendency to separate afterwards.

In view of the results so far obtained, the author considered it desirable to carry out further experiments on engines of the same compression, but with large valve openings designed to run normally at higher speeds than the Maudslay engine. He accordingly repeated the experiments on a standard car engine having a compression exactly equal to that of the Maudslay engine, but with cylinders 80 mm. by 150 mm., and such valve openings and lifts as enabled a speed of 2000 revolutions per minute to be easily attained. The results were quite sufficient to show that, even with the much higher piston speed of the engine, and with the slight increase in actual compression obtained under the new working conditions, it was possible to get an explosive mixture which would burn rapidly enough to exert at least as much power as petrol in an engine with a piston velocity of about 2000 feet per minute.

A point in these experiments which is regarded as of some considerable interest is the fact that it was impossible to discover any appreciable difference between methylated spirit when mixed with ordinary 90 per cent. benzol and when employed with the 50-90 per cent. quality. Further experiments, not yet completed, go to show that "straight run" naphtha—*i.e.*, the whole of the distillate boiling between 80° and 160° C.—can be equally well employed; and in such a case the amount of fuel available from gas-works tar would be increased from 300 to 400 per cent., whereas the increase in coke-oven fuel would be from 20 to 30 per cent.

The conclusions the author draws from the results of the investigations described are that, as pointed out in the introductory part of his paper, progress towards the final goal of using alcohol virtually as the sole fuel for motors is to be sought by experimental work on mixtures containing gradually diminishing amounts of benzol; and that these experiments, in conjunction with others made in France and Germany, certainly point to the possibility of the elimination of all but that very small percentage of benzol which is probably desirable, on Excise grounds as well as to aid in ease of starting; the influence of benzol being out of all proportion greater than the small quantity employed. Further experimental work is, however, immediately needed.

A SURVEY OF THE GAS-FIRE POSITION.

By H. James Yates, F.C.S., M.Inst.Mech.E.

[A University Lecture to the Manchester and District Junior Gas Association, Nov. 15.]

For a number of years past it has been my duty to point out from many platforms the inherently wrong principles on which the early types of gas-fire were constructed, and to set forth the principles which ought to underlie the construction of a truly hygienic and efficient gas-fire. I need, therefore, only rapidly summarize this part of the subject.

Threefold Division of Heat Units.

My present audience are all familiar with the fact that the heat from a gas-fire may be thought of as divisible into three portions: Radiant heat; convected heat; and heat passing away through the chimney for the purpose of carrying off the products of combustion, and of assisting in ventilating the apartment.

"Radiant" Heat Explained.

With regard to the first of these, it may be desirable to give in some detail an explanation of radiant heat. All hot bodies must be regarded as having their particles in a state of vibration; the higher the temperature of the body, the more rapid are the vibrations, and *vice versâ*. For example, a bar of iron heated at one end will gradually transmit its vibrations through the bar to the other end, which then appears hot. This is transmission by conduction. But even in the best conductors the propagation of the vibratory motion is slow. The case is different when we stand before a screen in front of a fire. Immediately the screen is removed, we feel a sensation of heat. The heat passes from the fire to ourselves without sensibly affecting the temperature of the air through which it passes. To explain this, scientists suppose that all space is occupied by a subtle and all-pervasive fluid of great tenuity and elasticity. It permeates everything, including solid bodies, and is called "the ether." The vibrating particles of a heated body communicate their motion to the ether around them, the particles of which are sent in successive vibrations. These vibrations travel through the ether in space with the velocity of light. When they reach another body, the motion is communicated to the particles of that body, and it becomes hot. This propagation of motion through the ether is termed radiation; and a ray of heat is merely a series of waves moving in a certain direction. I hope I have made it plain that the radiation is not manifested as heat until it strikes some solid body; and hence arises the distinction between the respective physiological effects of the two modes of heat-transference—convection and radiation.

"Dryness" of Air, and "Dew-Point."

As you are doubtless aware, that distinction is that radiant heat does not directly warm the air, but warms the occupants of the room and the objects in it; while convection currents—particularly when at a high temperature, as was the case with the older gas-fires—involve the raising of the temperature of the air to such a degree that its dew-point and its capacity for absorbing moisture are also considerably raised.

Moisture Contained in 1 Cubic Foot of Saturated Air (Glaisher's Tables).		Extra Moisture Contained in 1 Cubic Foot of Saturated Air after a Rise of 10° Fahr. (Glaisher's Tables).	
32° Fahr.	2·1 grains	From 32°–42°	1·0 grain
55° ,,	4·9 ,,	42°–52°	1·3 grains
60° ,,	5·8 ,,	52°–62°	1·8 ,,
70° ,,	8·0 ,,	62°–72°	2·3 ,,
		72°–82°	3·2 ,,

As a result of this increased moisture-absorbing capacity, the skin, nose, and throat of the occupant had to give up moisture to the atmosphere; and physical discomfort was caused. The paradoxical result of this was that the occupants of a room frequently appeared to suffer from two opposite discomforts—viz., they were at once too warm and too cold. The over-warmed air abstracted moisture from their bodies as I have explained, making them feel, in one sense dry, and therefore hot; while the walls, owing to the deficiency of radiant heat from the stove, were comparatively cold, and so abstracted heat from the bodies of the occupants, and thus occasioned chilly sensations at the same time. Further than this, the charring of organic dust which always settled on the highly-heated air-warming parts of the stove caused smell, and subsequent discomfort.

The Old Prejudice: Its Cause and Its Removal.

There could only be one result from this state of matters; gas as a medium for domestic heating acquired an ill name, and gas heating remained the fad of the few rather than the comfort of the many. For my own part, though a gas-stove maker, I found I could not endure the atmosphere of a gas-fire heated room, and hence my setting myself to investigate the causes of the discomfort, with a view to their removal. In this endeavour, one condition had to be kept steadily in view—viz., that, as the convection devices in gas-fires had been introduced in order to give the highest possible amount of fuel economy in working, any reduction of the convected heat ought to be accompanied by an increase of radiant heat; otherwise there would be a serious step backwards as regards economy. More important still, it was also evident that, apart from its value as an economic compensation for reduced convection, the increase of radiant heat was precisely what was wanted to revolutionize the gas-fire from a comfort point of view. Accordingly, one of the first things to do was to get rid of the special air-heating contrivances, and to increase the radiant heat by bringing as much of the radiating part of the fire as possible to the front of the stove—*i.e.*, to make the fire shallower and wider, so as to prevent more heat units passing up the flue than were absolutely necessary for product-removing and ventilating purposes.

The Introduction of the Shallow-Fire and Wide-Fire Principles.

This brought about the introduction of the shallow-fire principle, consisting in the use of one depth of "fuel" only, and also the wide-fire principle; gas-fires having hitherto consisted of a heating chamber which was deep, and (compared with the coal-fire) narrow. Another defect which had to be remedied was the interference with the flame, and consequent imperfect combustion, arising from irregular contact of the "fuel balls" with the flame. This led, through several stages of development, to the invention of a fire-front in which each burner teat was surmounted by one hollow columnar fire-clay radiant, which was in actual contact only with the outer envelope of the flame—the inner cone being left undisturbed.

Dispensing with the "Fuel-Guard."

To increase still further the effective radiation, the time-honoured cast-iron fret—necessary in the old fires to retain the "fuel"—was removed from the front of the radiants. This step forward proved to be one of the most important features in the increase of radiant efficiency. A few minutes ago, I recalled to you the way in which the old type of gas-fire acted, and how the discomforts attendant upon it were produced. Let me now briefly summarize the working of a modern gas-fire, constructed on the lines I have sketched, and the way in which it yields comfortable and genial warmth.

The Employment of Scientific Methods.

In most modern gas-fires, the stove body is quite cool—the hand can, in fact, bear contact with it at nearly any part. Hence only a comparatively small proportion of the total heat developed is given off as convected heat, and, instead of this involving an over-warm atmosphere in the apartment, it means only a gradual raising of the temperature to such a moderate extent as to prevent any feeling of coldness in the air. Once the fire has been alight for a sufficient time for its radiant heat to warm the furniture and the walls as well as the occupants of the room, these in turn give off a further low-temperature convection, which I may call "secondary convection," as distinct from "primary convection" yielded by the stove body itself. From these two sources the air of the room is kept comfortable, without any sense of "dryness" or overheating, as the air never becomes too warm, and the occupants do not feel chilly because, the walls being warm, the body does not lose heat to them by radiation.

In this way the modern gas-fire has become the most comfortable and the most healthful of domestic heating media; and the entire rearrangement of the conditions as regards radiant heat—I refer particularly to the shallow-fire and wide-fire principles, as well as to the gradual perfecting of the radiant itself, and dispensing with the "fuel guard"—have much more than compensated, as regards economy, for the reduction in convected heat. It is these radical changes and their consequent advantages which have occasioned the wonderfully wide and rapid spread of gas-fire heating which has been the most outstanding feature in the history of the industry within the last few years.

No one is in a position to know better, or to value more highly, than I do the earnest good work which has been done, and is being done to-day, by many gas-stove makers in the endeavour to improve still further the position of gas-fire heating by the development of gas-fire apparatus. In this connection, I have at this moment only one anxiety. Many of you will know how difficult a task it was at the outset of the new gas-fire movement to persuade gas-stove makers, gas engineers, and the public at large, that the time had come for concentration upon radiant heat, and for the reduction in a very large measure of the amount and the temperature of the convected heat. Now it is quite possible for over-zeal to err in the opposite direction, and to pursue the effort after increased radiant-heat percentages "not wisely but too well." This is a direction in which all of us gas-stove makers are liable to be tempted. To yield to this temptation may, I fear, be actually a retrograde step. My own feeling is that it is not desirable to aim at too highly concentrated radiation from narrow radiating areas, but rather to have a properly proportioned percentage of radiant heat distributed from a sufficiently wide radiating surface. Even now it is sometimes complained of by users of gas-fires that they experience a certain discomfort in sitting in front of them, owing to the intense heat striking, for example, on the face. We shall all be agreed—gas-fire makers and gas engineers alike—that it would be worse than useless to make a fetish of radiant heat *per se*, no matter what value it might have for the moment as a talking or selling point. It must always be borne well in mind that our aim in gas-fire construction is to supersede the coal-fire—for many reasons, and not least for the sake of a purer atmosphere. And it is well, I think, to make

sure that we do not carry any virtue of the present gas-fire to such excess as would make the fire not so comfortable in all respects as the coal-fire, or cause any revulsion of public feeling in favour of that older form of heating.

Flue-Heat and the Balance.

Reverting to the threefold division of the heat yielded by the gas-fire, which I mentioned earlier in this paper, the first point which it is essential to determine is what percentage of the total heat units yielded should be allowed to pass up the chimney for the removal of the combustion products, and for aiding ventilation. The balance of the heat units have then to be allocated between radiation and primary low-temperature convection. In this allocation the great thing to be aimed at is the maintenance of a correct proportion between the three, because, in addition to what I have already said, it has to be borne in mind that any undue increase in one of the three would upset their relative proportions, and cause an undue decrease in one or both of the others.

The Problem in Practice.

In matters of this kind it is unfortunate that gas-fire makers are compelled to work under such exceptional difficulties. In the first place, the apparatus, while efficient, must be quite cheap. It must, however, be remembered, that relatively to the cheapest forms of coal-fire, the initial cost of even the cheapest gas-fire must be higher. In the next place, the stove itself must be pleasing to the eye in artistic design, and its appearance, when heated up, must be as cheerful as that of the coal-fire to which we have been accustomed. Thirdly, the construction must be such as to permit of the cost of maintenance to the gas authority being reduced to the lowest point. For example, while it is quite possible to construct radiants to give exceptionally high efficiency, and to be pleasing to the eye as regards incandescence, yet this may in the long run prove of no advantage to either the maker or the user, if it is counterbalanced by consequent fragility, with resultant increased cost of renewals.

"Flue-Heat" and Ventilation.

I have already made incidental reference to the part played by the gas-fire in ventilation, both as regards the removal of its own combustion products and the due changing of the air in the room. I have, on a number of occasions in recent years, laid it down that, in order to be regarded as perfect from a health point of view, a gas-fire must be so constructed that, when it is connected with a chimney under ordinary conditions, it will not permit any of its products of combustion to enter the room.

Canopy Position, and Radiation Loss.

The remaining aspect of the ventilation question has reference to the amount of air induced to pass up the chimney. Seeing that a gas-fire is an apparatus which must never be used except in connection with a chimney, it follows that this ventilating or "hygienic efficiency" question necessarily relates itself to what I have described as ordinary conditions in respect to the chimney. Unless, however, means are taken to ensure that the ventilating air which is induced to pass through the flue shall not come in contact with the top part of the radiants, there is a cooling effect on these which reduces the radiant efficiency. I have found that conditions of this sort arise when the degree of vertical opening between the top of the radiant and the bottom edge of the canopy is unduly reduced, so that the incoming ventilating air has no alternative route but one in contact with the radiants. What has to be done, and can be done—but only with proper and careful design—is to avoid this method, with the consequent loss of radiant efficiency which it involves, and yet give due ventilation; and my research work all goes to prove that, in order to accomplish this, the lower edge of the canopy must not overlap the upper ends of the radiants, but must be raised well above them.

Over a year ago, when the claim was made for a certain construction of gas-fire that it got rid of the products of combustion without the aid of a chimney "pull," I criticized, not the object, but the method of construction by which it was sought to be attained—that it employed, among other expedients, that of bringing the canopy down to the radiants. I disagreed with the view expressed on behalf of this method of construction, that it involved no loss of radiant heat—pointing out that, when the chimney "pull" came into play, heat loss was bound to take place. My criticism was afterwards confirmed by independent tests made by Professor Bone, the highest authority on the subject, and I have since continued to adhere steadily to the principle of the raised canopy, as I have done ever since I introduced it with the "Wizard" fire in 1907. It has been interesting to notice various makers raising their canopies; and, since I made the criticism referred to, some makers have reduced the height of their radiants, which is equivalent to raising the canopy.

In this week's technical press, I once more find my view as to the loss of radiant heat with the canopy construction referred to supported by figures given in a lecture by Mr. H. Hartley. He shows that, when the chimney draught is increased, a fire with a canopy $4\frac{3}{4}$ inches from the top of the radiants only suffers a loss in one case of 0·4 unit, and in the other of 0·7 unit in the figure for percentage radiation. In a paper I lately read before the British Association, my figures for a fire with a canopy $3\frac{3}{4}$ inches above the radiants showed a loss of 0·3 unit in the figure for percentage, when the chimney draught was increased. These figures confirm my view that a raised canopy allows of good draught without loss of radiation. Mr. Hartley further shows a test of a canopy $2\frac{1}{2}$ inches from the radiants; and with this fire the figure for percentage radiation drops by 2 units when the draught is increased. My own test on a fire of the construction that I criticized—viz., one with the canopy level with the top of the radiants—showed a decrease of 4 units with increased draught. Thus these figures—once more from an independent source—fully substantiate my own, and confirm my position as to the loss which takes place with a lowered canopy when increased draught comes into play. The first two results above show that the radiants are below the level of influence of draught, while the last two show that the further the canopy is lowered beyond this, the greater is the loss of radiation with increased draught.

Actual Distance of Top of Radiants Below the Canopy. Inches.	Reduction in Figure for Percentage Radiation by Increased Chimney Draught.	
$4\frac{3}{4}$. two experiments	0·4 0·7	*i.e.*, the radiants are below the influence of chimney draught.
$3\frac{3}{4}$	0·3	
$2\frac{1}{2}$	2·0	*i.e.*, the radiants are within the influence of the chimney draught.
Level	4·0	

This is not the first instance in which I have found that, having after due experience and test taken up a certain position, and steadily adhered to it through both contradiction and misinterpretation, the consensus of laboratory tests and practical trial has endorsed my view.

Testing Apparatus and Test Methods.

The progress of gas-fire development was retarded in the early days by the lack of methods adequate to determine the effect of the various alterations made in its design and construction. I have already described the general trend of improvement from fires giving mainly high-temperature convection to fires giving mainly radiation. The development of the latter type was in a large measure due to the aid of reliable and accurate methods of testing.

In the old days, black bulb thermometers, thermopiles, and other instruments indicating only intensity were used in attempting to assess the value of the radiant energy emitted from a fire. Why did these fail to give any definite results? In the first place, they measured only temperature or intensity of radiation at a given point. A black bulb thermometer placed in front of a fire will eventually indicate a certain temperature, and will remain steady as long as the conditions are constant. This means that a certain amount of radiant heat is falling on the thermometer and being absorbed, while at the same time the same amount is being lost by radiation. The gain and the loss are balanced at the particular temperature indicated on the thermometer; otherwise, of course, the indicated temperature would go on rising till the thermometer burst. There is no practical method of determining the value in calories of this heat falling on the thermometer, and similar disadvantages apply to thermopiles. In those days it was not recognized that, even for measuring the relative radiation intensities of different fires, such methods were inadequate and misleading.

The Law of Inverse Squares.

As you are all aware, the intensity of radiation falling on a given surface varies inversely as the square of the distance from the source of radiation. For reasons into which I need not enter, the law of inverse squares (which governs heat distribution as well as light distribution—both being radiations) can only apply all the way when the radiation emanates from a point. If the source of radiation be of appreciable area, the law will not apply till the surface exposed to the rays is beyond a certain distance from their source. This distance becomes greater the larger the source of radiation. But attempts have been made from time to time to compare fires of different sizes and shapes by their respective effects on either a thermometer or on a thermopile placed, say, within a few feet of the fire. To show the uselessness of this, I may say that the radiation from a 17-inch gas-fire only begins to conform to this law of inverse squares when placed over 10 feet from the surface exposed to it. At shorter distances than this, the intensity registered is less than required by the law referred to.

One-Direction Testing *v.* Hemispherical.

So far I have dealt with radiation in one direction only, and have shown why the relative intensity of radiation in that direction from two different fires can only be measured from and beyond a certain minimum distance from the fire. There is now the question of the distribution of the radiation over the hemisphere in front of its source. If all fires were exactly alike in shape of radiants, curvature of the fire-front, and the depth to which it is sunk in the casting, width and reflecting quality of the fender, and other details, some sort of a case might be made out for a one-direction method of testing (which, of course, would give only *intensity* of radiation), as long as fires were placed at or beyond the necessary distance from the receiving instrument. It is, however, scarcely necessary to say that it is precisely in these particulars that fires differ, and that the symmetry of the distribution of radiation over the hemisphere is affected to a greater or less degree by each of them. A one-direction determination may be, therefore, not only inaccurate, but positively misleading, as a criterion of the relative hemispherical radiation intensities of two gas-fires.

I think it is unnecessary to press this point any further before

an audience of gas engineers, as the matter has been well thrashed out in respect of the candle-powers of lighting burners. It is sufficient to say one has only to put four reflectors round a gas fire to get in any one direction a very high intensity indeed!

To return to my point, it is that the radiation from a gas fire must be determined hemispherically. So far I have only dealt with relative *intensities* at a point, which may be likened to relative light intensities as determined by an illumination photometer. It is very different when we come to heat rays, as their more correct name, radiant *energy*, indicates. The aim of the modern gas-fire, as I have said, is to give the greater portion of the heat available for warming the room in the form of radiation or radiant energy; and any method which determines the intensity only of this radiant energy gives no indication of the value of the radiant energy in terms of heat. Intensity may be likened to the *quality* of radiant energy, whereas what we require is its *quantity* in terms of heat.

Although physicists know a great deal about the nature and laws of radiant energy, it is admittedly no easy matter to devise a method for the accurate estimation of the radiant energy from a gas-fire; for the latter, by reason of its construction and contour, cannot be treated either as a geometrical surface of definite form or as radiating symmetrically, and none are more alive to the difficulties of the problem than scientific men themselves. The fact that the heat sent out by a fire is made up partly of radiation from red-hot surfaces, partly of radiation from surfaces at much lower temperatures, and partly of convected heat, complicates the problem of measuring its "radiant efficiency." Moreover, it is essential that the experimental method adopted shall not interfere with the free access of air to the fire, nor set up abnormal "combustion conditions," nor be subject either to errors due to lag or to the influence of air movements in the testing-room.

The Leeds Method.

The present accepted method is that adopted by the Joint Committee appointed in 1907 by the Institution of Gas Engineers and the University of Leeds, to investigate gas-fires. The Committee recognized that the first thing to settle was a method of estimating radiant energy in terms of heat. The Leeds method, as it is generally named, was the result. A full description of the method will be found in the "Transactions of the Institution of Gas Engineers" for 1909 and 1910; but I have here such parts of the apparatus as will enable me to demonstrate to you the procedure involved. I append to this paper a short account of the Leeds method as used by us, and of our method of determining flue heat and convected heat.

It will be seen that the Leeds method is a hemispherical one; and perhaps its chief merit lies in the fact that it involves no misleading assumption about the "radiation distribution" of any particular fire, but, on the contrary, actually determines it in each experiment. The radiation intensity in all directions is determined by the thermopile; and then, by means of the relationship established for each experiment between the sensible heat determined on the radiometer and the thermopile readings, these readings are converted into actual total heat radiated. In this way is found what percentage (or quantity) of the heat developed by the combustion of the gas in the fire is given out as radiation; and we are able to observe progress in a manner impossible if only intensity (or quality) of radiation is observed. The method is well conceived; and it is not difficult to carry out, as long as it is under the control of a skilled operator who has had considerable experience of heat measurement, and realizes the possible sources of error.

I see Mr. Hartley in the course of his recent lecture confirms what has been our own experience with the method—viz., that its margin of error is only about 1 per cent. We have used it in our own laboratories since its first publication; and during this prolonged (and, indeed, unrivalled) experience, we have found it reliable and, as I have said, substantially accurate. The chief criticism that has been made against it is on the score of time. We find, however, that we can comfortably make three radiation determinations of different fires in one day, and even four, if no time be lost. The actual test and all subsidiary operations can be done in about 1 hour and 10 minutes. It is simply a question of length of experience and systematized arrangements. Apart, however, from the question of time and its degree of accuracy, it gives much valuable information about the distribution of radiant energy from a particular fire.

Merely Calorimetric Tests Found Wanting.

Other (purely calorimetric) methods for measuring the radiant efficiency of a fire have been suggested—as, for instance, the absorption of all the radiation by a large hemispherical calorimeter. But a radiation calorimeter must intercept all the radiant energy that will fall on any hemisphere with the fire as the centre. If the calorimeter be large, it suffers three defects—first, that it is well-nigh impossible to get perfect circulation of water through it; secondly, that there are large losses from its cold side by radiation and convection; and, thirdly, it suffers from errors due to lag. If, at the other extreme, a small calorimeter be used, it must be placed so near the fire (to absorb all radiation) that the natural movement of the air currents is interfered with; and the results are vitiated in this way. These objections to a purely calorimetrical method would, I feel sure, be endorsed by all physicists who have given the matter special attention.

These views of mine on the disadvantage of the use of purely calorimetric methods have been borne out in a striking manner in two recent papers in the Technical Press. In one, which appeared some months ago, it was stated that the results indicated by the calorimeter above had to be multiplied by a factor 1·3 to bring them into line with the results obtained by the Leeds method. In the other, in this week's Technical Press, by Mr. W. J. A. Butterfield (who has in recent months been turning his attention to the testing of gas-fire radiation), in comparing methods of testing radiation, he states that the results indicated by the calorimeter only actually showed a percentage radiation some 10 units lower than that determined by the Leeds method.

Much as manufacturers of gas-fires are indebted to the scientific work organized and carried out under Professor Bone's supervision at the Leeds University by the Joint Committee, no one (and least of all, I have reason to know, Professor Bone himself) would think of asserting that nothing more remains to be done in the matter of measuring the radiation from gas-fires, whether "total radiation" or "radiation distribution." I have myself been working for some time past on the subject; and, convinced as I am of its importance, I have arranged for a co-operative research between the staff of my laboratories and Professor W. A. Bone and Professor H. L. Callendar of the Imperial College of Science and Technology, in the hope that such a combination may result in further benefits to the industry as a whole.

We are trying to find either an entirely new method or some way of supplementing or perfecting the Leeds method, so as to eliminate the present small margin of error, and reduce the time necessary for each experiment. Should we be fortunate enough to find our investigations resulting in a definitely improved method, we shall be prepared to make this public in the same way as I made public a couple of years ago particulars of my experience in the details of gas-fire construction—a disclosure which, I venture to think, has not been without a very beneficial influence on subsequent gas-fire construction.

Some Points Recalled.

Let me recall, in conclusion, that, with regard to gas-fire canopy construction, I have shown how completely the view that I have advocated and acted on ever since 1907 has been vindicated both by the fact of gas-stove makers raising their canopies, or taking an equivalent course, and by such independent testimony as I have cited from the Technical Press. I have shown why, up to the present, the Leeds method is the only adequate one available—particularly owing to its embodiment of the hemispherical principle.

I have referred to the threefold division of the heat units developed by the combustion—viz.: (1) Radiant heat; (2) convected heat; and (3) flue heat. In this connection, I trust I have made it clear that the term "flue heat" is a much more accurate one than "flue loss," and that the distinction is one of great practical importance. The heat passing off by the flue has its own specific functions to fulfill, and energy expended in doing necessary work is never "loss." It is only if and so far as a form of construction permits more heat to escape by the flue than the necessary work requires that the term "loss" becomes applicable.

I have endeavoured to show that, in striking the proportional heat-balance, the minimum flue heat necessary is the first point to be dealt with. The carrying-off of all combustion products, and the due stimulation of chimney ventilation, must be first of all ensured. The next point on which I lay stress is that, in allocating the heat units as between radiation and primary low-temperature convection, there must be a most careful proportioning of these to each other and to the minimum flue heat.

I have called attention to the temptation of aiming at the cultivation of radiant heat exclusively, and therefore excessively, and I have explained that this may lead to a degree of discomfort in the use of gas-fires such as might seriously check their popularity. This line of thought led to my raising the question as to whether further progress in gas-fire development does not lie in endeavouring after a properly proportioned percentage of radiant heat distributed from a sufficiently wide radiating surface, rather than in aiming at a highly intensified radiation from narrow radiating areas. This is a point to which I should like to direct particular attention.

Finally, we want, in practice, as far as may be, to reproduce in our homes the conditions of Nature which prevail outside. Those rays of the sun which, in their natural distribution, give due warmth with due comfort, would become intolerable if concentrated on the body, or a part of it, by a powerful lens. Further, conditions should be aimed at in which the functions of the skin should have adequate opportunity for their regular action, which is not possible with an intense and localized heat. I have endeavoured to suggest that uniformity of heat influence should be modified by breadth of radiating surface and wideness of distribution. Clearly these are not matters for hasty dogmatism. At present one can only "think aloud," so to speak, and let the matter be carefully thought over by all those interested. On such a point it would not be wise to attempt to speak in any tone of finality; but as the matter presents itself to me at present, I feel that the considerations I have named are worthy of being carefully weighed.

APPENDIX.

Determination of Radiation by the Leeds Method, as Used by John Wright and Co.

The fire of which the radiation is to be determined is placed at the centre of, and facing, an imaginary hemisphere, on the inner

surface of which all the radiation from the fire must fall. The value, expressed in calories, of the radiant energy falling on a particular one of the eighty-one specific portions into which the hemisphere is divided is determined by means of a radiometer, or, in other words, a radiation calorimeter, consisting of a number of blackened copper tubes through which water is flowing—the rise in temperature of a known weight of this water giving the heat falling on the radiometer. Two determinations are made. One of these is taken with the radiometer fully exposed to the fire; the other with its surface shielded from the radiant heat by a bright metal plate. The latter experiment determines the number of calories which are imparted to the water by the warm air of the room (convected heat), and which would otherwise remain erroneously included in the radiant heat; and these are deducted from the number determined by the former. It is necessary to mention that the determination made with the radiometer surface shielded is, so far as I am aware, not mentioned in the Leeds report, and that, in testing, its omission will cause the figure for the percentage of radiant heat to appear too high—in fact, the correction generally amounts to approximately 5 units in the radiant efficiency percentage.

After making the two radiometer determinations, the thermopile is substituted for the radiometer in front of the fire. This gives a reading in millivolts, and a proportional relation is thus established between actual calories as determined by the radiometer and millivolts as indicated by the thermopile. The thermopile is then moved successively to each of the remaining eighty positions into which the rest of the hemisphere is divided. Each reading—which only requires a few seconds—is thus equivalent to a proportional number of calories. Owing to the convergence of the lines of longitude from the equator to the north and south poles, a number of the eighty-one portions of the hemisphere are of diminished area; and as the radiometer surface remains constant, the result indicated for any such diminished portion by the thermopile (as representing the radiometer) would be excessive, as including radiation from adjoining portions. To correct for this, the thermopile readings taken above and below the equator are multiplied by the cosines of the respective vertical angles between the radii drawn to the centre of the portion and the equatorial radii.

The total of all the eighty-one corrected readings is converted into calories by means of the relationship already determined between the thermopile and the radiometer; the figure thus obtained being the total amount of heat radiated by the fire per hour. During the progress of the thermopile readings, periodical inspection is made of the gas-test meter, and the calorific value of the gas is taken. By these means, the total radiant energy sensible as heat, and its percentage of the total heat developed in the fire per hour, is ascertained.

[The lecturer here showed one of the sheets of John Wright and Co.'s fire-test book.]

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FIRE

RADIOMETER.

In	Out	Mins.	In	Out.
		0		
		1		
		2		
		3		
		4		
		5		
Water	cc	6		

Water cc

GAS.

Time.	Meter.	Difference.	Rate per Hour.	Meter. Press.	Meter. Temp. °F.	Meter. Temp. °C.	Room Temp.	Barometer.	
Average									

Tension of Aqueous Vapour mms.
Corrected Barometer mms.
Gas Rate (N.T.P.) cu. ft. per hr.
Calorific Value (Net) per cu. ft. N.T.P.
Calories per hour in Gas
Calories per hour on Radiometer
Total Calories per hour radiated

HEAT RADIATED %

THERMOPILE.

	80°	60°	40°	20°	0°	20°	40°	60°	80°	Total.	Corrected Total
80°											
60°											
40°											
20°											
0°											
20°											
40°											
60°											
80°											

Grand Total

METHOD OF DETERMINING FLUE HEAT—JOHN WRIGHT AND CO.

The heat going up the chimney (or flue heat) is estimated by taking the temperature of the mixture of air and products of combustion ascending the chimney and multiplying the respective amounts of the different constituents by their rise in temperature and by their respective specific heats.

METHOD OF ESTIMATING THE CONVECTED HEAT.

The convected heat given to the room by the fire cannot be estimated directly, since the greater portion of the radiant heat is ultimately converted to this form. It is, therefore, only estimated indirectly as the balance of the total heat developed by the burning gas which is not accounted for either as radiant heat or as flue heat.

In the flue gases, zones of widely varied temperature are perceptible. It is therefore necessary to use a number of thermometers in different positions, in order to ascertain correctly the temperature of the gases, particularly in the larger fires, which have correspondingly wide flue outlets. As might be expected, the CO_2 content of the zones is also different. When the fire is attached to a chimney, one sample is taken—as far away from the fire as is necessary to ensure the proper mixing of the various strata. [Should it be necessary to estimate the heat escaping from the flue outlet when the fire is not attached to a chimney, samples must be taken from different points close against the various thermometers.]

A continuous sample of the coal gas supplied to the fire is taken during each experiment. By explosion analysis with pure air, the amount of CO_2 afforded by, and the oxygen required for, the combustion of 100 volumes of gas is determined. The CO_2, oxygen, and CO already present in the gas are determined by absorption analysis; duly apportioning the oxygen used, enables the water vapour formed to be calculated. Generally, however, it is hardly necessary to proceed to this analysis, as only a very small error is introduced by assuming an average figure—say, 120 volumes of water vapour produced per 100 volumes of gas burned. The flue products having been analyzed for CO_2, all the data for the calculation are now complete. By taking the volumes of CO_2 produced per 100 volumes of gas burned and dividing them by the percentage of CO_2 in the flue gases, the volume of the latter per cubic foot of gas burned is ascertained. In this volume we know the actual amount of CO_2, also the nitrogen from the air used for combustion. The remainder is excess air. The calculated amount of water vapour must be added to get the total flue gases per cubic foot of the gas burned. Multiplying the actual volumes of the various gases thus ascertained by their respective specific heats, and by the rise in temperature, the sensible heat carried away by the flue gases per cubic foot of gas burned is ascertained. Division of this figure by the net calorific value of the gas per cubic foot gives the percentage of flue heat.

The list of papers to be read at the Royal Society of Arts after Christmas contains one by Mr. F. W. Goodenough, on "Coal Gas as a Fuel for Industrial Purposes."

We learn from the Secretary of the Scottish Junior Gas Association—Eastern District Section (Mr. Lawrence Farquhar, of Alloa) that a quarterly meeting will be held in the Museum, Tar Street, Perth, next Saturday afternoon, when two papers will be read—one by Mr. Henry Doran, of Granton, on "The Purification of Coal Gas;" and the other by Mr. A. R. Wilson, of Perth, on "Sulphate of Ammonia Manufacture."

PROGRESS IN ARTIFICIAL ILLUMINATION.

An American Illuminating Engineering Society Report.

At the Seventh Annual Convention of the American Illuminating Engineering Society, which was held at Pittsburgh (Pa.) a short time since, the Committee on Progress presented a long report, the text of which appears in the October "Transactions" of the Society. We extract from it the portions bearing specially on matters in which "JOURNAL" readers are interested.

GAS-LAMPS AND APPURTENANCES.

A large number of new types of gas lighting units have made their appearance in both hemispheres. Some of them have been designed with a view to more universal adaptability, such as a burner with a curved bunsen which may be turned up or down, and is therefore applicable to either upright or inverted burners; some with a view to ease of maintenance, such as one in which the main feature is the possibility of lifting from the fixture without the use of pliers; and some with a view to increased efficiency, such as one in which the mixture of gas and air issues at high velocity, resulting in an efficiency claimed to be double that of the standard type; also another lamp with an upright bunsen and an inverted mantle. Low-pressure high-efficiency lamps, particularly for outdoor use, and giving 1500-candle power, with an efficiency of nearly 40 candles per cubic foot, have been introduced abroad, but have not yet appeared in America.

What is probably the most important development in gas lighting during the past year has been the introduction of a high-power single-mantle inverted lamp, filling a place between the old small unit and the multiple-mantle lamp. The lamp gives from 180 to 225 mean spherical candles, according to the gas used and the pressure, and this occupies a space hitherto unfilled. A valuable feature of this lamp is the fact that, because of the single mantle, the light is concentrated, and reflectors and glassware may be designed with much greater precision than with the multiple-mantle lamp.

Hitherto one of the difficulties in connection with the use of high-pressure lamps has been the heat developed, which limited the kinds of glassware available, and also necessitated a globe of very great size. In a modification of one of the high-pressure inverted lamps now in wide use, particularly in England, a small silica cup, about 5 inches high, and therefore but little larger than the mantle itself, has been substituted for the globe hitherto used. This cup totally excludes the secondary air supply—all air for combustion being admitted as primary air. The lamp, moreover, is greatly reduced in size, and the reflector is omitted. It is claimed that, after allowing for the absorption of light by the silica cup, 10 per cent. increase in efficiency is obtained. These cups are made for lamps of from 60 to 1500 candle power. They are very durable, and will not break if the mantle gives way and the flame strikes them.

A new high-pressure lamp has also been developed in the United States, designed particularly for street lighting, and working under a pressure of 55 inches of water, or 2 lbs. per square inch. These lamps are at present made in two sizes—500 and 1100 candle power respectively—and have an efficiency of more than 50 candles per cubic foot of gas per hour. The mantles are of artificial silk, and have a life of upwards of 400 hours, with practically no depreciation in candle power. High-pressure lighting, however, has not been developed in the United States to quite the same extent as abroad.

A most interesting and valuable investigation was made to determine the cause of the falling off in candle power of the incandescent mantle. Microscopical examination showed that when new the ash seemed to be made up of very small particles, making an opaque and light-giving structure. As the mantle was heated, these particles gradually fused together to form larger particles, and, by degrees, a large transparent mass, which, by the laws of physics, is comparatively without light-giving properties. Other experiments were made to apportion to each part of the lamp its share of the deterioration. Under favourable conditions, this in 1000 hours' continuous burning was: For the mantle alone, 2½ per cent.; for the burner alone, 2½ per cent.; for the glassware alone, 10 per cent.—a total deterioration of 15 per cent., of which, by proper maintenance, 12½ per cent. could be eliminated.

Automatic gas ignition is having a steady growth. Pilot lights are increasing in number, while the jump-spark and filament igniters are gradually coming into use. Distance control by means of electrically operated gas-cocks and also pneumatic control in connection with pilot and jump-spark ignition are being extensively employed, particularly last year. It should be noted here that pilot lights have been improved by adopting the bunsen principle and by better protection, so that the danger of extinction is greatly reduced. Self-kindling mantles are also receiving attention, and one improvement recently made in this type of mantle was to mix ammonium chloride with rhodium chloride. The metallic rhodium deposited is of a silver grey, and comes to full intensity without presenting a dark streak down the mantle. It has since been found that lithium chloride is cheaper and works better.

The pyrophoric alloys are also in process of development, and are now on the market. A new composition of the alloy has been found which, instead of giving a shower of sparks, produces a long flame—thus rendering the friction-wheel unnecessary. This alloy is air-proof, and does not disintegrate like the cerium alloy.

STREET LIGHTING.

The question of street lighting is attracting extraordinary attention. People are no longer satisfied with just enough light to see to move around safely, but are coming to a realizing sense of the advertising and artistic values of ample light. While much publicity is being secured to ornamental lighting, the majority of the business has been connected with the ordinary street lighting, which is, in the electric field, practically working in the direction of the use of the luminous arc lamp, and the tungsten filament incandescent lamp. The increased standard of general street lighting has been largely accelerated by the reduced cost of light; and while it has taken on no distinctively new form, the standard of lumination intensity (not necessarily the size of units) has been raised very considerably.

An interesting test was made in Switzerland to find the relative advantages of arc and metallic-filament incandescent electric lamps. Two streets of equal length were lighted with 10-ampere electric lamps and 500-candle incandescent lamps respectively. The choice between the two forms of lighting was left to 29 trolley car motormen. Of these, 25 favoured the metallic-filament lamp on account of lessened glare and irritation to the eyes. The mercury-vapour lamp has been suggested as a street-lighting unit; but thus far its use for this purpose has been hardly more than a suggestion, though in one city lighted by a municipal electric plant a group of merchants installed six quartz tube lamps to show (by contrast) the poor character of the general street lighting.

An unfortunate dispute has arisen in one of the large cities of England over the relative merits of high-pressure gas and flaming arc lamps. Two streets were lighted by the rival illuminants, and experts representing each of the industries made illumination measurements and prepared reports. The tests were entirely in favour of the electric lamps; but the fact was brought out that the gas-lamps were improperly adjusted and installed, so that no conclusions could be drawn as to the relative merits of the two systems. The whole affair caused much argument and a good deal of acrimonious discussion on the part of the advocates of the two systems.

Gas street lighting has made great strides in both England and Continental Europe, where high-pressure lighting is in considerable favour. The automatic lighting of gas-lamps is also making rapid progress on the other side of the Atlantic; the lamps in a large number of towns being equipped with these appliances. Two systems of automatic lighters are in extensive use—one being operated by a momentary addition to the street main pressure, and the other by means of a clock arrangement on each post, so that the lamps operate individually and independently. Highly encouraging reports as to the satisfactory and economical working of these systems have been made.

In America, street lighting by gas, while making steady progress, has not experienced the rapid growth that is so marked abroad. Automatic lighting has not as yet obtained a foothold; and, except for two minor installations, there is no high-pressure street lighting. Another difference between European and American practice is that abroad inverted burners are becoming universal; while at home, except for a two-mantle 150-candle lamp, the inverted burner is not used. Ornamental street lighting by gas is spreading—a number of prominent installations having been made. Increased interest in street lighting does not seem to be unusual, as a recent item in a French technical journal contains the statement that in that country, out of 10,000 villages or communes of more than 1000 inhabitants, 6000 are without public lighting.

PHOTOMETRY.

The search for a primary standard of light still goes on, and the requirements for one have been the subject of papers appearing from time to time during the past year. But little actual progress in this direction has been made public. At the last meeting of the German Illuminating Engineering Society, however, a paper was read discussing the question of an absolute standard; and it was proposed to investigate the distribution of energy in the spectrum of the source of light to be investigated, to determine the sensibility curve of the human eye for different wave lengths, to calculate therefrom the distribution of light intensity in the spectrum, and, finally, to arrive at the total candle power. An extended discussion of the possibilities of using the black body as the basis of a rational unit of light followed the reading of this paper.

In phases of photometry other than in regard to standards, the work during the past year has been on greatly varied lines. Conveniences in working the present type of photometer, selenium and other photo-electric cells, the reliability of the flicker photometer, and the application of the radiometer, have all been the subject of study.

About a year ago, a simple method of comparing the colours of artificial illuminants was described, based on the observation of their comparative intensities through a photometer. In the eye-piece of the instrument, blue, green, yellow, red, and deep-red glasses were inserted successively, and in this way comparisons were made of the spectrum intensities of these colours. In connection with colour photometry, the flicker photometer has received its share of attention, and a discussion has taken place as to whether this type does actually measure relative light inten-

sities. It has already been pretty well established that it gave more consistent results when used to measure lights of dissimilar colours; but there was a question as to whether there was not a "luminosity sense" distinct from the "colour sense." Recent careful investigations indicate, however, that the flicker photometer gives true brightness, though it gives at low intensities a reversed Purkinje effect which makes it necessary to use caution in its employment.

A suggestion made to eliminate colour difference in the photometry of incandescent lamps is to run the standard lamp at such a voltage that its colour corresponds to that of the lamp under test, and then determine the candle power of the standard from a previously plotted curve of candle powers and voltages.

A recent illumination photometer consists of a Lummer-Brodhun arrangement with lateral windows to which are attached two rectangular tubes—one directed towards the screen upon which the illumination is received, and which may be set at any angle and in any plane; and the other terminating in an elbow leading to a standard tungsten lamp, in which elbow is set a standard reflecting screen. In this photometer the standard tungsten lamp is movable, travelling along a scale.

A rather novel method of reducing the quantity of light for photometric purposes was described in a paper read before the German Illuminating Engineering Society. If the light used for illuminating the surface under test be reduced by placing in its path an opaque disc with an open sector, the illumination of the surface will not be uniform if the disc is stationary. The author, therefore, allows the light passing through the sector to be received in an Ulbricht sphere, the inner surface of which is uniformly lighted by reflection, so far as it is not illuminated by incident light. To complete the arrangement so as to have a portable photometer for white light, a white ring surface, with an opening in it, is provided on the outside of the sphere. The observer changes the angle of the sector until the hole in the ring becomes invisible; thus obtaining a measure of the light by which the white surface with the hole is illuminated.

WOOD WASTE AS FUEL FOR GAS-PRODUCERS.

At the last Meeting of the Junior Institution of Engineers, Mr. G. E. Lygo gave a lecture on the above-named subject, with special reference to plants of the Whitfield type for generating gas. The following are the salient points of the discourse.

Though the value of wood as a fuel for gas-producers has long been known, it is only recently that gas plant makers have given serious attention to the subject. The higher price of a wood-waste plant as compared with an anthracite plant, and the low price of anthracite, did not induce power users to instal them. With the increased cost of coal, however, manufacturers having combustible waste materials of little value and difficult to dispose of looked out for means of utilizing them; and the advent of wood-waste suction plants reliable in working has given them an opportunity of effecting considerable economy. All kinds of wood, from sawdust to pieces 6 inches diameter, surface peat, &c., may be consumed in the generator, and the gas produced used in gas-engines.

The plant employed consists of a generator, cooler and washer, tar-extractor, and dryer; and that in which the lecturer is interested has an anti-fluctuator. The area of the generator is governed by the nature and size of the fuel; but, roughly speaking, it is 2½ times that required for coal fuel. The depth of the fuel depends upon its size and density. The gas has to be cooled and washed as soon as it leaves the generator, or the heavy tar and dust in suspension will deposit and choke the connecting pipes. The gas must also be thoroughly cooled before it enters the tar-extractor, in order that the tar may condense; otherwise it is quite impossible to extract it entirely.

The calorific value of wood when air-dried is approximately 6000 B.Th.U. per pound. The amount consumed per brake-horse-power will depend upon the moisture, which amounts to 10 to 20 per cent. in air-dried wood and 30 to 50 per cent. in freshly felled timber. Fuel which contains an excess of moisture must be dried until it does not exceed 60 per cent.; otherwise it is difficult to make the generator fire burn evenly. The gas produced is of higher value than that from anthracite—viz., about 150 to 170 B.Th.U. per cubic foot, against 120 to 140 B.Th.U. from the latter. A sample of gas from a wood plant, when analyzed, showed its combustible constituents to be: H, 12·9; CO, 27·6; CH_4, 2·2.

The lecturer said it was difficult to give comparative costs of working with other systems, as the value of the fuel used depended upon any other purposes for which it might be utilized. If its value were 10s. a ton, it would be equal to anthracite at 25s. a ton; and then it was a question for power users to decide which system would be most convenient. A steam-boiler specially designed to utilize wood waste consumed 6 to 10 lbs. per B.H.P.-hour, against 2½ to 3 lbs. in a producer. A test made with a Whitfield producer supplying an 84 B.H.P. engine coupled to a 105-volt dynamo gave 540 Board of Trade units for 2072 lbs. of fuel consumed, or 3·83 lbs. of fuel per kilowatt, and 2·6 lbs. per horse power. The test extended over ten hours, and the fuel, consisting of oak and elm sawdust and chips from wood-working machinery, had no value for other purposes.

IMPROVED LIGHTING OF A SCHOOLROOM.

In a paper read by Mr. E. F. Kingsbury at a recent meeting of the American Illuminating Engineering Society, he described some experiments carried out by him in the illumination of a schoolroom by gas.

The room comprised a large open central portion, with alcoves on two sides which could be closed and utilized for classes. The lighting requirements demand that the sides should be treated as distinctive rooms, and that two plans should be adopted. The usual solution is one or more chandeliers over the main floor, and a smaller one in each alcove. In the present case, a stained-glass ceiling over the centre could be used advantageously, and in each alcove there were two wall outlets. Several reasons for placing the light sources above the ceiling in the central portion existed. The light was removed from the field of vision, and utilized the beauty of the stained glass, which any lamps hanging below would tend to obscure. The attic was easy of access for maintenance. The lighting of the sides was more difficult, as utilizing the outlets brought the lights too low, for the audience would sit where the light from one row of lamps would be square in the eyes. Even well-frosted globes were objectionable, as the walls were dark and the contrast marked.

The room was 60 feet long, 35 feet wide, and 35 feet high. At a distance of 12 feet from the front and back walls open archways rose, the walls in front at the top curving inwardly to meet a glass panelled ceiling, 28 feet long by 42 feet wide, each panel 3 feet square. Heavy blinds slid between the arch posts at the rear to make three separate rooms. The wall north of the main floor, composed of three heavy Venetian blinds, which could be raised to include the low ceiling room beyond it as a part of the school room, rose to only one-third of the full height of the room; the space above being entirely open. These three blinds, however, were closed throughout the test. At the south were large double sliding-doors in the centre; the body of the wall being plain, and curving inwardly at the top to meet the ceiling, as in the front and the rear. Wooden wainscoting, 5 feet high, extended around the room—the north side excepted. All woodwork was dark oak, and the walls were dark green. The room was lighted in the daytime by three large stained-glass windows at the rear; those in front being of no use, because they were covered by a later built portion of the church adjoining the school.

The body of the room was originally lighted by twelve small inverted incandescent gas-burners at each end, distributed uniformly along horizontal beams 15 feet high at the base of the arches, and supplied with pilots and pendant chains for lighting. The illumination of the alcoves was by three small inverted units and some open-flame gas-burners. This installation was unsatisfactory, for two reasons. First, the reaching-up with a hook to catch 24 rings was monotonous and time-consuming, especially if the room was rather dark, or if the rings were set swinging before being caught. Secondly, the glare from the row at one end in the eyes of a person sitting at the other end was annoying. These two rows of lights were therefore removed, and the glass ceiling utilized by placing a four-burner inverted incandescent gas arc above four of the panels. The magnet-valve pilot system of ignition was used; two push-buttons on the main floor each lighting a pair of lamps. Each of the lamps was equipped with a polished aluminium conical focussing reflector, 11 inches in diameter at the top, 26 inches at the bottom, and 16 inches high. The mantles were 30 inches, and the bottom of the reflector 16 inches, from the ceiling. Opal globes were decided upon, as clear globes gave a very bright spot in the centre, with bright concentric rings. The spots were not visible except when looking up at the lights; but the illumination on the floor below any lamp was nearly double that half-way between. Opal globes obviated this; and the system has been in use a year and a half and has given satisfaction.

Illumination measurements were taken with the whole room fully lighted, and with the centre lamps and the lamps at one end lighted separately, to show the effect of the two distinct systems on each other. All readings were taken in a 30-inch plane, except the readings on the platform, which were made on a plane 2 feet higher than those on the floor. The average on the 30-inch plane in the centre was 1·08 foot-candles, which, though seemingly low, was found to be ample. The author described the installation to show that, in rooms cut up and hard to illuminate, the very peculiarities might be utilized to provide something at once unusual and practical.

In the list of Mayors for the current municipal year are the names of the following men associated with gas or water supply: Mr. E. A. Brotherton, the Lord Mayor of Leeds, head of the well-known firm of Messrs. Brotherton and Co., Limited, ammonia and tar distillers; Alderman G. S. Elliott, the re-elected Mayor of Islington, is the Vice-Chairman of the Metropolitan Water Board; Alderman E. Finn, the Mayor of Lydd for the twenty-fifth year in succession, was formerly Chairman of the Lydd Gas Company; Alderman J. M. Frost, the Mayor of Chester, is the Chairman of the Gas Company; Mr. J. Lewis, the Mayor of Carmarthen, is also Chairman of the Gas Company; Mr. J. W. Saville, the Mayor of Wakefield, is a representative of Messrs. Brotherton and Co., Limited; Alderman R. Thornton, the Vice-Chairman of the Elland Gas Company, was re-elected at Brighouse.

CARBONIZATION OF COAL IN VERTICAL RETORTS.

At the recent annual meeting of the American Gas Institute, a paper entitled "Some Notes on the Carbonization of Coal in Vertical Retorts" was submitted by Mr. O. B. Evans. In it, the author described a number of experiments made upon the phenomena occurring in a vertical retort of the intermittent type. They include observations of temperatures within the charge, pressures, analyses of the gases from the core of the charge, composition of gases distilled at low temperatures, resistance to the flow of gases through coal in the various stages of distillation, a study of the progress of carbonization as shown by sections cut through vertical pipes filled with coal and carbonized for various periods, and an argument based upon these experiments, giving the proportion of gas travelling through the core of the charge and through the coke. The following are extracts from the paper.

The setting selected was of the United Gas Improvement Company's design, located at Philadelphia. The installation consists of five benches of nines; the retorts being 18 ft. 6 in. long, 10 in. by 14 in. at the top, and 15½ in. by 21½ in. at the bottom. When filled to within 4 feet of the top, each retort will hold about 950 lbs. of coal. The coal used throughout the experiments was a West Virginia gas coal, analyzing as follows:

Table I.

	Per Cent.
Moisture (air dried)	0·8
Volatile combustible	38·6
Fixed carbon	53·7
Ash	6·9
Total.	100·0

Ultimate Analysis of Dry Sample.

	Per Cent.
Carbon	77·9
Hydrogen	5·3
Oxygen	6·8
Nitrogen	1·7
Sulphur	1·4
Ash	6·9
Total.	100·0

Temperature of the Core.

The first experiment was to determine the temperature of the core of the charge at various points throughout the period of carbonization. A 1¼-inch wrought-iron pipe, closed at bottom, was placed in the retort and held in position by spiders. The retort was then charged with screened coal varying in size from about 1 to 2 inch cube. A special thermocouple 21 feet long was then lowered into the 1¼-inch pipe, and the temperature read by means of a high-resistance (132 ohms) millivolt meter. The usual ½-inch protecting pipe round the couple was cut off 3 inches from the hot junction, so as to expose the latter directly to the heated surface of the 1¼-inch tube, and thereby ensure more accurate readings. The couple was allowed to stay in one position for 10 minutes to attain the correct temperature before being moved to the next. A section of the retort, showing the location of the points at which temperatures were taken, is given in fig. 1; while the results of these observations are plotted in fig. 2. The latter shows clearly the low temperature existing in the core of the charge during the period of transition from coal to coke, and agrees in general with published similar experiments made on coke ovens. When the carbonizing period is about half over (at which time about 60 per cent. of the gas by volume has been given off, and nearly all the tar) the temperature rises rapidly.

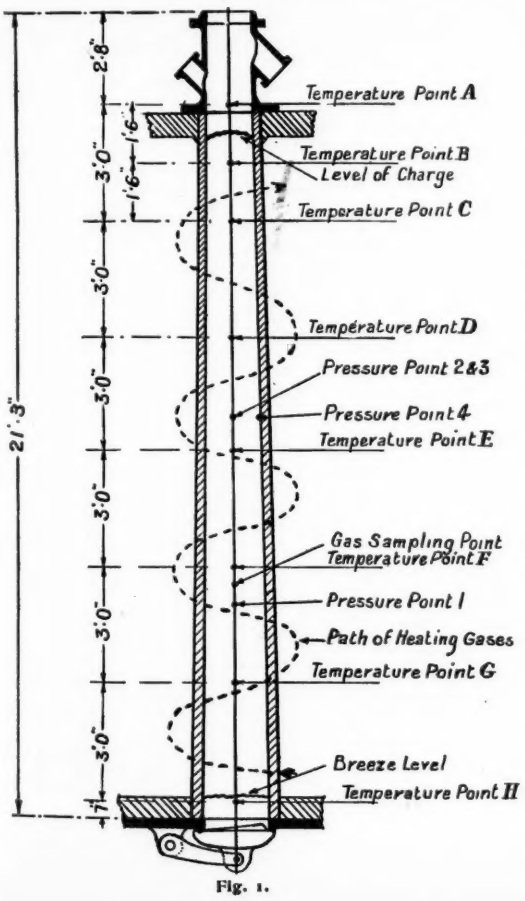


Fig. 1.

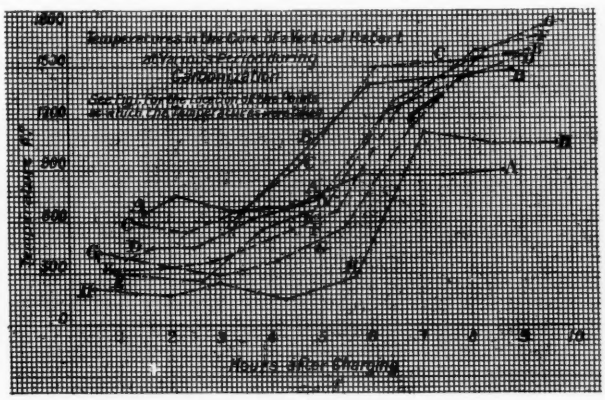


Fig. 2.

In order that the escape of the gas through the core of the charge may be as free as possible, it is desirable that the top of the core shall not carbonize until after the bottom. Should the top become plastic before the bottom, the gas generated in the bottom would be compelled to break through this plastic mass, or else escape through the hot coke. The flow of gas through hot coke is generally considered injurious, as the valuable constituents may be decomposed.

The top portion of the charge reaches the plastic stage (at a temperature of about 700° Fahr.) nearly two hours ahead of the bottom; indicating that with the heats used (sufficient to burn off the charge in ten hours) the sectional area of the retort should have been greater throughout. With the same taper, the relative area of the top and bottom approaches more nearly unity as the actual area increases. Since the temperature of the retort at the bottom is several hundred degrees above that at the top, it is evident that, were the area of the top increased in a sufficiently greater proportion than that at the bottom (as could be done by retaining the same taper and increasing the cross-sectional dimensions of the retort), the core at the top would become plastic later than that at the bottom. On the other hand, if with this particular retort the heats were reduced so as to burn off the charge in (say) twelve instead of ten hours, the difference in temperature between the top of the retort and the bottom would be greater with the twelve-hour than with the ten-hour charge; and since the top section would be subjected to a lower temperature, its core would carbonize later. A certain taper is advisable to ensure the dropping of the charge. The actual design of a retort is therefore dependent upon the system of heating used, and upon the desired time of carbonization.

Pressures in the Charge.

To determine the actual pressures in the charge at various periods of carbonization, ½-inch pipes, open at the bottom, were lowered into the retorts and held in position by spiders while the retorts were being charged. The results of these observations show, as would be expected, that the pressure with coal of nearly uniform size—viz., the ½-inch cube—is less than when the size varies considerably. This follows from the fact that the percentage of voids in any material increases as this material approaches more nearly a uniform size. When the coal reaches a temperature of about 700° Fahr. it melts, and the gas generated does not escape till the pressure rises sufficiently for it to break its way through this sticky mass. While the ends of the pressure pipes are only 5 inches apart in a horizontal direction,

there is found a maximum difference in pressure between these two points of about 30 inches when the direction of flow is in towards the core, and 40 inches when it is towards the retort wall. This shows that the plastic layer of coal when strengthened by a coke backing is more resistant to gas flow than when backed by green coal. With regard to the pressure on the bottom lid, the high pressure—five hours after charging—occurs when the top of the charge becomes plastic (at about 700°), and shows the increase in pressure on the lower lids caused by the top section carbonizing before the bottom.

Low-Temperature Carbonization.

During the past few years, numerous investigations have been made into the carbonization of bituminous coals at low temperatures. From experiments conducted by Messrs. Porter and Ovitz, as well as tests made by the United Gas Improvement Company, the following table is given as probably representing the products obtained when gas coal is distilled at low temperatures.

Table II.

Temperature of Carbonization, deg. F.	800	1000	1200	1400	1600	1800
Yield of gas, c. ft., per pound	0·4	1·4	2·4	3·4	4·4	5·4
Tar, gallons, per 2000 lbs.	11·0	22·0	26·0	27·0	23·0	..
Tar, gallons, per 1000 c. ft.	13·8	7·9	5·4	4·0	2·6	..
Gas (calculated free from nitrogen and oxygen)—						
Illuminants	9·0	5·5	5·0	4·5	4·0	3·5
CO	8·5	6·2	6·7	6·8	6·9	7·0
H	5·0	24·0	38·0	47·5	56·0	63·7
C_nH_{2n+2}	65·5	59·3	47·6	39·1	31·5	24·5
CO_2	12·0	5·0	2·7	2·1	1·6	1·3
	100·0	100·0	100·0	100·0	100·0	100·0
Ratio $\frac{\text{Ill.} + H + C_nH_{2n+2}}{H}$	15·9	3·70	2·38	1·92	1·63	1·44

The ratio of the hydrogen to the sum of the hydrogen and the hydrocarbons decreases as the temperature of carbonization increases. This ratio would seem, therefore, to identify any gas, and show from the analysis at what temperature it had been distilled. It will be noted that the tar yielded per ton increases with the temperature to a maximum, and then decreases, while the tar per 1000 cubic feet of gas corrected to 30 inches of the barometer and 60° Fahr., and saturated with water vapour at this pressure and temperature, is a maximum at low temperature and decreases as the temperature rises. The large yield of tar per 1000 cubic feet at low temperature is due, of course, not to the fact that the quantity of tar produced is great, but rather to the fact that the yield of gas is very low. The decrease in tar per ton at the higher temperatues is due to the breaking-down of the tarry oils to gas and free carbon. In Table III. is given the composition of the gases actually evolved at the different temperatures; the analyses being calculated from those given in Table II. Here it will be noticed that there is a more rapid increase in the percentage of hydrogen and a decrease in the percentage of paraffins as the temperature increases.

Table III.

Temperature limit, deg. Fahr.	Below 800	800 to 1000	1000 to 1200	1200 to 1400	1400 to 1600	1600 to 1800
Cubic feet of gas per pound	0·4	1·0	1·0	1·0	1·0	1·0
Illuminants	9·0	4·0	4·3	3·3	2·3	1·3
CO	8·5	5·3	8·0	6·4	7·3	7·4
H_2	5·0	31·7	57·0	71·0	85·4	97·3
C_nH_{2n+2}	65·5	56·8	30·7	19·3	5 0	−6·0*
CO_2	12·0	2·2	..	..	..	..
Totals.	100·0	100·0	100·0	100·0	100·0	100·0

* This signifies that not only are no gases of the paraffin series generated, but that some of those distilled at lower temperatures have been decomposed.

The quantity of volatile matter given off at various temperatures was determined by heating a mass of coal (about 180 grammes) in an electric furnace, and maintaining it at the desired temperature until all the volatile matter had escaped. The results of these tests showed that while the weight of volatile matter given off at low temperatures is comparatively great, the actual gas evolved is low; the explanation of this being that at the low temperatures all the moisture in the coal, as well as practically all the water of combination, is vaporized, while the specific gravity of the gas is high. This, in part, accounts for the apparent large volume of gas yielded from the charge of coal when first introduced into a retort.

Resistance to the Flow of Gas through a Charge.

To determine the resistance to gas flow through the charge, when carbonized at different temperatures, a 1¼-inch pipe was filled to depths of 4 and 8½ inches with coal of various sizes, and placed vertically in an electric furnace. Gas was passed through this coal (gas being used instead of air to eliminate any oxidizing action), and the pressure required to force it through at a given rate was noted. The charge was then heated and maintained at the various temperatures until all the gas which could be distilled at this temperature was driven off, when the resistance to flow was again measured. The results of these tests are shown in Table IV.

The progress of carbonization can be readily followed through the plastic stage, in which the resistance is very high, to the coking stage, in which it gradually decreases. The effect of fine coal *versus* screened coal is shown by the marked increase in resistance of the former before carbonization. After the coke has formed, the resistance is apparently independent of the size of the original coal. Under actual working conditions, however, these results would probably be modified. Due to the clogging of the core by the condensable tarry vapours, the increase in resistance through fine coal over coarse coal is no doubt greater than is shown by the small-scale experiments. Also, since a given volume of retort will hold a greater weight of fine than of screened coal, the coke made from the latter probably contains more channels for the flow of gas than does that made from fine coal, and will therefore have a lower resistance. The coke produced in the experiment was very light and porous. In actual practice, this coke is materially denser, probably due both to the weight to which it is subjected while coking, and to the fact that the pores fill up with lampblack. We should expect, therefore, to find the actual resistances considerably higher than indicated.

The approximate rate of flow through the top section of a vertical retort for the first five hours after charging is 6 cubic feet of gas per square inch of area per hour; while in the above described tests upon coal 8½ inches deep the rate was 10 cubic feet. Assuming that approximately half the gas flows through the plastic envelope surrounding the uncarbonized coal, the rate of flow would not be far from 10 cubic feet per hour per square foot of surface. Some of the tarry oils distilled from the coke outside the plastic mass probably condense while passing through it, tending to further increase its resistance; so that in practice, even with the extremely low rate of flow, the drop in pressure through it may be at times as much as 30 inches.

Travel of the Gas.

In considering the subject of the travel of the gas, whether it is through the cold core of green coal or through the partially coked mass, due regard must be paid to the character of the original coal. It is evident that the gas flow will be along the path of least resistance. It is also evident that with lump coal the resistance to flow through the core is considerably less than with fine coal. Therefore, it seems reasonable to suppose that if the gas flow is divided—some escaping through the core and the remainder through the coke—the proportion of gas escaping through the core will be much greater when the original charge is composed of lump coal than if composed of fine coal. An examination of coke after it has cooled will not give an accurate clue as to its conditions while hot; the above experiments showing clearly the cracking of the coke during cooling as measured by the sudden drop in resistance.

In the course of the preceding tests, the coal began to melt at a temperature of about 700° Fahr., becoming plastic at 750°, and again solidifying at 825°. The coke formed at 825° was powdered, and again heated to a temperature of 1400°. No cementing of these powdered particles occurred; showing that the phenomenon of

Table IV.

Coal ½-Inch Cube, 8½ Inches Deep, 12 Cubic Feet of Gas per Hour.				Coal Dust 8½ Inches Deep, 12 Cubic Feet of Gas per Hour.				Coal, 50 per Cent. ½-Inch Lump, 50 per Cent. Dust. 4 Inches Deep, 2 Cubic Feet of Gas per Hour.			
Temperature.	Pres.	Cub. Ft. per Hour.	Pres. to Pass 12 Cub. Ft. per Hr.	Temperature.	Pres.	Cub. Ft. per Hour.	Pres. to Pass 12 Cub. Ft. per Hr.	Temperature.	Pres.	Cub. Ft. per Hour.	Pres. to Pass 2 Cub. Ft. per Hr.
Atmospheric	0·035	12·0	0·035	Atmospheric	1·64	11·2	1·88	Atmospheric	0·11	2·12	0·10
670° Fahr.	0·144	12·5	0·133	670° Fahr.	6·73	3·3	89·00	680° Fahr.	0·39	1·28	0·95
760° ,,	2·70	..	..	760° ,,	7·40	..	..	750° ,,	4·80	1·74	6·34
850° ,,	2·70	..	..	850° ,,	7·70	3·3	102·00	760° ,,	7·60	1·26	19·20
940° ,,	2·50	6·82	7·70	940° ,,	2·96	10·3	4·02	830° ,,	11·80	0·79	76·00
1100° ,,	2·04	12·16	1·99	1100° ,,	2·00	10·9	2·42	840° ,,	11·40	1·38	24·00
1200° ,,	0·74	12·5	0·68	1200° ,,	1·44	11·2	1·65	920° ,,	0·33	1·89	0·37
1300° ,,	0·39	10·9	0·47	1300° ,,	0·97	12·3	0·92	1100° ,,	0·20	2·35	0·14
1400° ,,	0·31	11·7	0·32	1400° ,,	0·75	12·4	0·70	1200° ,,	0·09	2·67	0·05
								1300° ,,	0·08	2·46	0·05
								1400° ,,	0·07	1·77	0·09
After cooling to atmospheric temperature	0·062	12·0	0·062		0·093	12·1	0·092				

coking took place at a temperature below 825° Fahr., and that above this temperature the binding property was destroyed.

To study further the generation of gas and the formation of coke in vertical retorts, the following experiments were made: A 1-inch pipe was placed in the core of a retort—the end being 6 feet above the bottom of the charge and about 9 feet below the top of a normal charge, and samples of gas were drawn through this pipe and analyzed. To prevent any over-heating of the gas during its passage through the pipe in the upper portion of the retort, and to ensure an accurate sample of the gas actually in the core, this particular retort was filled full of coal—thus eliminating the ordinary free space used for fixing the gas. The remaining eight retorts of the bench were charged at the same time (leaving the usual superheating space above the charge), and simultaneous samples were collected from the hydraulic main and the sampling pipe above mentioned. The coal used was run of crusher, varying from 3-inch lumps to dust. The results obtained are given in Table V.

TABLE V.

	Sample from Hydraulic Main.			Sample from the Axis of the Charge Six Feet above the Bottom.		
Hours after charging .	1	4½	8	1	4½	8
Illuminants. . .	6·0	4·4	2·1	5·8	5·5	1·0
CO	6·8	7·5	7·9	7·3	5·1	9·3
H_2	37·1	48·7	61·9	43·4	29·2	68·2
CH_4	33·6	33·2	24·1	28·8	26·2	16·9
C_2H_6.	8·1	1·1	0·0	7·6	21·5	0·8
CO_2	3·8	1·5	1·3	3·8	8 5	1·0
O_2	0·7	0·4	0·8	0·7	0·9	0·7
N_2	3·9	3·2	1·9	2·6	3·1	2·1
Total . .	100·0	100·0	100·0	100·0	100·0	100·0
Calculated free from nitrogen and oxygen—						
Illuminants . .	6·3	4·5	2·2	6·0	5·7	1·0
CO	7·1	7·8	8·1	7·5	5·3	9·6
H_2	38·9	50·6	63·6	44·5	30·4	70·2
CH_4	35·2	34·5	24·8	29·8	27·3	17·4
C_2H_6.	8 5	1·1	0·0	7·8	22·4	0·8
CO_2	4·0	1·5	1·3	4·0	8·9	1·0
Total . .	100·0	100·0	100·0	100·0	100·0	100·0
Ratio: $\frac{\text{Ill.}+H+CH_4+C_2H_6}{H}$	2·28	1·79	1·42	1·97	2·82	1·27

In the case of the gas collected from the hydraulic main, it will be noticed that the percentage of hydrogen gradually increases with the time of carbonization; while the percentages of marsh gas (CH_4) and ethane (C_2H_6) decreases. The gas collected from the pipe shows a rather peculiar variation, in that the hydrogen starts out fairly high, decreases, and again increases. The marsh gas shows a gradual decrease, while the ethane increases, and then rapidly decreases. Ethane is more easily decomposed by heat than is marsh gas; hence we must conclude that the variation in the hydrogen is due, in some part at any rate, to the different quantities of ethane decomposed.

From an inspection of the ratio of the hydrogen to the sum of the hydrogen and the hydrocarbons, it would seem as though the gas collected would correspond to that carbonized at the following temperatures:—

Sample rom	Time after Charging. Hours.	Corresponding Temperatures of Carbonization.
Hydraulic main . .	1	1240° Fahr.
	4½	1460 ,,
	8	1800 ,,
Core of charge. . .	1	1380 ,,
	4½	1700 ,,
	8	1900 ,,

This would indicate that the first gas flowing up through the core of the charge has been distilled at a comparatively high temperature. Subsequent gas flowing through the core is generated first at a gradually decreasing, and later at an increasing, temperature. The average gas issuing from the top of the retort, as determined by samples collected from the hydraulic main, corresponds to that distilled at a gradually increasing temperature. This might be due to its passage through the fixing surface at the top of the retort (and commercial practice has shown very clearly the effect of this superheating—an excess resulting in the formation of lamp-black and a deficiency producing poor candle power), or it may be due to the fact that some of the gas generated passes through the core of the charge and the remainder through the heated layer of coke—the average temperature of this mixture rising with the progress of carbonization.

Gas at the rate of about 25 cubic feet per hour was also drawn through the sampling pipe for two-hour periods, and condensed to 35° Fahr. The tar obtained is shown in Table VI. The quantity condensed near the end of the charge was too small to analyze.

TABLE VI.

Hours after charging. .	0 to 2	3½ to 5½	7 to 9
Corrected gas, cubic feet	58·00	48·00	50·00
Tar, gallons	0·066	0·525	0·004
Tar, gallons per 1000 cubic feet	1·10	10·90	0·08
Specific gravity of tar .	0·9901	0·9880	—
Unsulphonated matter, per cent. by volume .	—	—	—
Distillation, per cent. by volume—			
Up to 300° Fahr. .	2·0	1·9	
300°–400° ,, . .	25 9	8·8	
400°–500° ,, . .	30·7	28·1	
500°–600° ,, . .	17·8	32 1	
600°–700° ,, . .	10·9	21·4	
700°–750° ,, . .	4·6	5·7	
	91·9	98·0	
Coke, per cent. by weight	9·53	1·24	

The quantity of tar produced per 1000 cubic feet may be higher at the start than that shown. Condensation of the tarry vapours probably occurred during the passage of the gas through the cooler upper portions of the core; this tar re-evaporating later, and increasing the apparent quantity obtained in the second sample. However, it is evident that the tar yield indicates the generation of a higher-temperature gas in the first two hours after charging than between the third-and-a-half and the fifth-and-a-half hour period; thus agreeing with the deductions made from the analyses of the gases given in Table V.

PROGRESS OF CARBONIZATION.

To show the progress of carbonization, 8-inch iron pipes 12 feet long, were filled with coal and lowered into vertical retorts which had been partially filled with coke after the previous charges had been dropped. These pipes were allowed to remain in the retorts for various lengths of time, and then withdrawn, and sections cut through close to the bottom. Photographs of these sections are shown in figs. 3, 4, and 5. The pipes were subjected to carbonizing periods of 1, 2½, and 5 hours respectively; and they show clearly the travel of the very thin plastic layer in towards the centre. Analyses of the coke for volatile matter were made from the different portions of the various charges; and they are given in Table VII.

TABLE VII.

	Time of Carbonization. 1 Hour.			2½ Hours.			5 Hours.		
Distance of centre of layer from wall of pipe, in inches . .	1/16	¼	¾	⅜	1½	2	3½	⅜	2	3⅜
Width of layer, do. . .	⅜	¾	¼	¾	¾	1	1½	¾	4	¾
Percentage of volatile matter in layer . .	10·8	15·5	34·5	7·2	12·0	17·0	26·6	3·6	5·5	6·3
Probable temperature of layer, degs. Fahr. .	1240	1060	700	1440	1200	1000	800	1740	1560	1500

The volume of gas distilled from coal above 700° Fahr. increases approximately directly with the temperature. The volume of gas-producing material increases with the time of carbonization until all the gas has been driven off from the coke lying next to the walls. Thereafter the volume remains nearly constant until the core reaches the plastic stage, when it decreases. If the flow of heat into the charge were uniform from hour to hour, the quantity of gas produced would be small at the beginning of a charge and

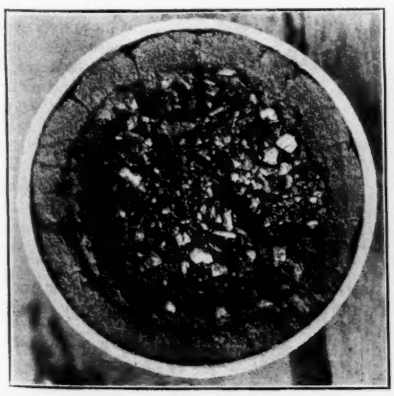


Fig. 3.—Time of Carbonization, One Hour.

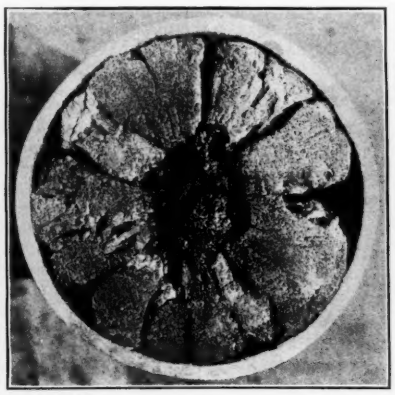


Fig. 4.—Time of Carbonization, 2½ Hours.

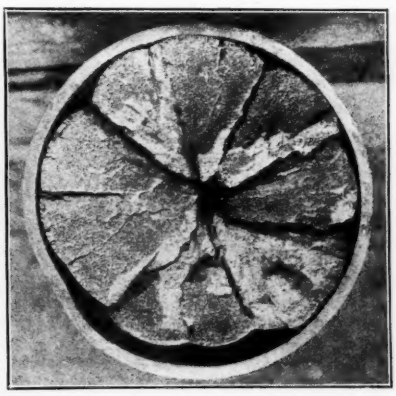


Fig. 5.—Time of Carbonization, Five Hours.

increase to a maximum at which it would remain till the core had begun to give off gas freely, when it would decrease.

Conclusions.

The experiments described may be summarized as indicating the following points:

Gas coal becomes plastic with the free evolution of gas at about 700° Fahr., and solidifies at 825° Fahr. This plastic envelope around the uncoked coal is very sharply defined, and is about ⅜-inch thick. When of considerable thickness—say, 8½ inches, as in the laboratory experiment—it is almost impervious to gas at high rates of flow. When thin, and at the low rate of flow occurring in practice, the drop in pressure through the plastic envelope probably does not average more than 30 inches.

The resistance of partially coked coal—say, that of coal carbonized at 1000° Fahr.—is about seven times that of coal carbonized at 1400° Fahr., about twice that of coal dust, and about 85 times that of screened lump coal, when passing 10 cubic feet of gas per square inch of area per hour.

If coal is heated to 825° Fahr., coke is formed. If this coke is then broken up and heated to 1400°, no further cementing of the broken pieces takes place. The centre of the charge in this particular vertical retort near the top attains a temperature of 600° about three hours after charging, and 800° about an hour later. The centre of the charge near the bottom reaches 600° in 5½ hours, and 800° half-an-hour later. The entire core reaches 1400° at about the same time (7⅛ hours). Consequently, since the bottom of the retort itself is several hundred degrees hotter than the top, the average temperature of a horizontal zone near the top of the retort must, after 7½ hours, be greater than that of a similar zone near the bottom.

The maximum pressure in the core of the retort occurs somewhere about when the temperature reaches between 800° and 1000°. The actual pressure depends upon the free space in the coal; screened coal of uniform size giving the maximum free space, and therefore producing the minimum pressure. The difference in pressure within a horizontal distance of 5 inches may be as much as 40 inches of water.

The gas collected from the core of a charge near the bottom one hour after charging is a product of higher temperature than that collected 4½ hours after charging. Gas collected from the same point after the core has passed the plastic stage is a higher temperature product than either. The average gas leaving the retort is a product of gradually increasing temperatures. These, in general, are higher than those at which the gas flowing through the core has been produced. After the core has passed the plastic stage, the gas collected in the core of the charge at the bottom may be a higher temperature product than that collected in the core near the top of the charge; so that the average gas leaving the retort may be a product of lower average temperature than that in the bottom of the core.

From the data already given, the following argument seems to be warranted: The maximum temperature of the plastic envelope is about 825° Fahr.; hence, the average gas generated by this envelope must be at some lower temperature. The gas collected near the bottom of the core of the charge for the first half of the carbonizing period is a higher-temperature product than that generated by the plastic envelope. The gas collected in the core in the first hour after charging has been distilled at a higher temperature than that collected 4½ hours after charging.

Since the gas collected in the core has been generated above 825°, and since in its flow through the core it is not subjected to a greater temperature than this for the first four hours, it follows that this gas must have been distilled from the material lying outside the plastic envelope, as well as from the envelope itself, and must therefore have passed through the envelope.

The gas produced in the lower portion of the charge outside

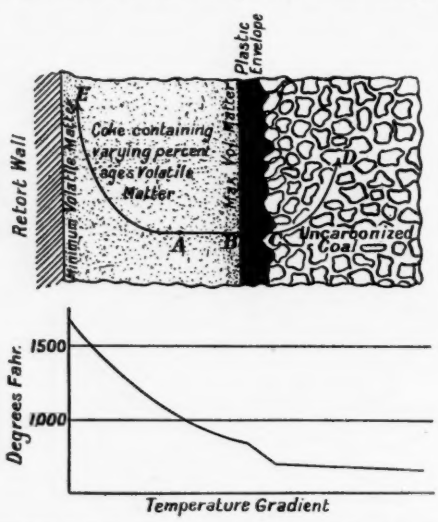


Fig. 6.—Vertical Half-Section through a Portion of the Charge, showing the Path of Travel of the Gases and the Temperature Gradient.

the plastic envelope (say, at A in the diagram, fig. 6) has two distinct paths of travel—one horizontally through the partially formed coke and the plastic layer, and then vertically through the green core (A B C D); and the other vertically through the partially formed coke near the walls (A E). This being true, then A must be the point of highest pressure; and all the gas distilled between A and F escapes by the path A E; and that distilled between A and C leaves by the path A B C D.

It has been shown that the temperature of distillation of the gas flowing from A by the path A B C D decreases with the time after charging. Therefore the temperature of A must decrease. The quantity of gas given off from any mass of coal while the zone C A is passing it, will be a smaller proportion of the ultimate total gas distilled from this coal when the temperature of A is low than when it is high. Thus the lower the temperature of A, the smaller the proportion of gas flowing along the path A B C D. Since the temperature of B (the high-temperature side of the plastic envelope) remains constant at about 825°, and since the flow of heat is in from the retort wall F, it follows that as the temperature of A decreases A must move toward the plastic envelope, or the distance A B must decrease.

We may arrive at this conclusion by another process of reasoning. The drop in pressure along the path A B C D must be at all times equal to that along the path A E. The drop along this path must be a maximum at the beginning of the charge, not only because the area between A and the retort wall is smallest at that time, but also because the partially formed coke offers a greater resistance than does the more completely formed coke produced later. It follows, therefore, that the drop in pressure along the path A B C D, being at all times equal to that along A E, must be greatest at the beginning of the charge. The pressure at A is also greatest at this time.

The resistance of the path A B C D will be made up of the resistance A B of the partially formed coke between the high-pressure point A and the plastic layer of B C through the plastic envelope and of C D through the green core. The resistance B C through the plastic layer is probably constant for a given rate of flow, since there is no reason to believe that with a given size of coal the plastic envelope varies in thickness or resistance.

As already shown, the actual quantity of gas passing through the plastic envelope decreases with the progress of carbonization. Therefore the actual drop in pressure through the envelope will decrease. The area of the core diminishes with the progress of carbonization, while the quantity of gas flowing also decreases; so that the net result produced is a greater drop in pressure. Probably the decrease in the pressure drop through B C (due to the slower rate of flow) is about equal to the increase through C D; and the total drop B C D remains nearly constant. Any variation in the total pressure difference between A and D must then be due to a variation between A and B.

From this it follows that the fall in pressure between A and B, and hence the actual distance A B, is a maximum at the beginning of a charge, and decreases with the time after charging. We therefore have a zone of high-pressure points A lying between the plastic envelope B C and the retort wall. While they are both moving towards the core, this zone travels more rapidly than the plastic envelope. The temperature of the pressure zone decreases as it approaches the plastic envelope, or decreases with the time of carbonization. The gas distilled from the portion of the charge lying between A and C flows through the core; while that distilled from the portion between A and the retort wall escapes by way of the path A E next to the wall.

The diagram shows a portion of the charge, and indicates what may occur with a coal of varying size in which the resistance is high. About half-an-hour after the beginning of the charge, the pressure zone A is at the wall, and practically all the gas breaks through the plastic envelope into the core. The quantity of gas made is a maximum; so that the actual resistance to flow through the incompletely carbonized coal A B and the plastic envelope B C would be high. At the end of two hours, the pressure zone A might be 1¼ inches from the retort wall, and the plastic envelope B C 2¼ inches away—the temperature of A being 1300°. All the gas distilled below this temperature would pass into the core; all that distilled above it escaping along the retort walls. After four hours, the temperature of the high-pressure point would be (say) 1150°, and its distance from the retort wall about 3 inches. The distance between A and the plastic envelope would have decreased from 1 inch at the end of two hours to ¾ inch after four hours. Two hours after charging, all the gas distilled below 1300°, or 54 per cent. of the gas made at that time, flows through the core. At the end of four hours, all gas distilled below 1150°, or 40 per cent., leaves by this path. For the first six hours after charging, when 70 per cent. of the total gas is given off, about 45 per cent. of it travels through the core and 35 per cent. through the hot coke next to the retort walls. In general, the maximum pressure will decrease as the pressure-point A moves towards the core. Then the plastic envelope disappears, and the pressure decreases rapidly; the gas flow being distributed more or less uniformly throughout the charge.

In the case of the particular retort on which these experiments were made, the maximum pressure occurs shortly before the plastic envelope reaches the core. This is undoubtedly due to the fact that the top coal carbonizes before the bottom. This obstructs the flow of gas through the upper portion of the core, and forces it out through the coke—so increasing the pressure.

The figures already indicated vary greatly with the character

of the coal and the position in the charge. Coal showing high resistance (either dust or of varying size) will increase the resistance to flow through the core, and consequently decrease the quantity of gas flowing. This gas will also be a lower-temperature product than when using coal of low resistance. The resistance to flow along the walls, compared with the resistance through the core, will be greater at the bottom than at the top of the charge. Consequently, a higher percentage of the gas generated at the bottom will flow through the core than of that generated at the top.

In general, therefore, the proportion of gas travelling through the core will increase with the percentage of voids in the original coal and with the distance below the top of the charge, and will decrease as carbonization advances. The gas evolved at low temperatures, which would be more liable to injury by excessive heat, escapes through the cool core. That evolved at higher temperatures, which escapes along the walls, is composed chiefly of hydrogen and marsh gas, and is therefore not readily injured by heat.

REFRACTORY MATERIALS.

There was no falling off, either in respect to the number of those attending or the interest taken by them in the proceedings, when Dr. RUDOLF LESSING last Friday evening gave the second of his three lectures on "Refractory Materials," at the Westminster Technical Institute.

Resuming consideration of the subject of the treatment of fire-clays, the lecturer pointed out that from 15 to 20 per cent. of water is used for tempering, &c.; the exact amount depending upon how moist the mixture may be worked. Standard-sized fire-bricks are moulded in so-called "slop" fashion, smoothed off in wooden frames. For retorts and blocks, and wherever grog is used to a large extent, the moisture cannot be so high; for the mixture requires more mechanical working to get it of close texture. The tougher it is, the better for this purpose. The moulded articles have to be dried, in most cases in "stoves" the floor of which is heated by steam or the waste gases from the kilns. After lying on the floor for about 24 hours, they are dry enough not to lose shape in handling; and they are then stacked for a week or so until completely dry. It is most important that the articles should be perfectly dry before they are put in the kiln, as otherwise the material might fly or crack. In the use of artificial dryers, no forced draught should be employed; for it will injure the brick by cracking it. In the case of one kind of dryer used on the Continent, the goods are placed on trucks soon after being moulded, and are then pushed at short intervals through a tunnel, along which hot waste gases are passed in the opposite direction to the trucks. A special regenerative method is used to get rid of moist air. Wherever slop-moulded fire-bricks are pressed in a machine press, they must dry for about 24 hours, into a "leather hard" condition; a crust being thus formed on the outside which prevents damage to the exterior.

As to gas-retorts, it was pointed out that these are produced in different ways—being both hand and machine made. In England, a mandrel is used for hand making, and the material is moulded in stages, about 3 feet at a time; each section being allowed to stand till dry. On the Continent, a double mould is used, giving the exact shape and thickness to the retort. In this case, also, the process is carried out a few feet at the time. The mixture is not moulded, but rammed in, so as to force out any air-bubbles from the material, and give the closest possible texture. In this way, using a tough mixture, a very firm material can be obtained. For machine making, the mixture is dropped in a cylinder, and is compressed by pressure; the retort being pressed out below on to a table, which is lowered at the rate at which the pressing proceeds—similar to the manufacturing process of ordinary drain pipes. Dr. Lessing expressed the opinion that retorts so made should be as good as hand-made ones; but, of course, the skill of the worker counts in both processes. As to cost, there is little to choose between the two methods. Mention was made of a new system of casting retorts, depending on a physico-chemical reaction by adding substances of a colloidal character.

When the articles made of refractory material have been completely dried, they are ready to proceed with the next stage, which consists of the firing in a kiln. The construction of the kiln in which this process is to be carried out is a matter of great importance; the principal features to be aimed at being (1) an even heat, (2) a heat sufficiently high to do the necessary work, and (3) fuel economy. There are many types of kiln employed; but the most common in this country is the old round beehive shaped kiln. Another type used in the North is of practically the same cross-section, but oblong in plan. The kilns have to be heated to a certain temperature; and then the fires are withdrawn. In this process, which takes 24 hours or more, the combined water of the clay is driven off, at from 500° to 600° C. The temperature is then raised and the goods are thoroughly burned in another 12 hours. After this the kiln is allowed to cool to the temperature of the atmosphere, so that a man may enter it and remove the contents. A good deal of fuel and time are, of course, lost by a kiln taking too long over the firing. Usually the heat is allowed to escape without any effort at recuperation; but attempts have been made to collect and use the waste heat. A number of kilns are connected by ducts, which enable the waste gases from one kiln to pass through another kiln. The adoption of such a system means a great saving in fuel. Gaseous firing in place of direct firing also effects economy in working; the secondary air being regulated as in an ordinary retort-setting.

Remarking on the advantage of adopting a continuous kiln, the lecturer illustrated and explained the form invented by Hoffmann in 1858. The working of this kiln is divided into zones—a pre-heating zone, a heating zone, a cooling zone, and a cold zone. The hot zones are divided from the cold ones by paper dampers, which are kept in position by the draught; and when it is intended that the fire should proceed into the next chamber, the paper is ripped off. Other slides showed the common brick kiln and the gas-fired continuous kiln. In the latter producer gas is used; the amount being regulated by dampers. A further subject was the Mendheim kiln, as used on the Continent. In this each chamber is partitioned off by a fire-brick wall, and a complicated system of regeneration is arranged. Then there was the tunnel kiln, which has only been adopted during the last few years, and consists of a tunnel with open ends, along which trucks travel with the goods to be burnt. Producer gas is used for heating the tunnel. The great advantage of the tunnel kiln lies in the fact that the fires are stationary, and the goods move along (while in continuous ring kilns the goods are stationary and the fire is moved along), thus leading to considerable fuel economy. Tunnel kilns may be compared in their working to continuous vertical retorts. In treating refractory material, gaseous firing is advantageous, inasmuch as it is cleaner and more easily adjusted.

Turning to the question of the firing itself, Dr. Lessing said it is not sufficient to raise a brick to a certain temperature, but at that temperature the air must have ready access, in order to oxidize the organic substances in the clay. There should be no core left in the brick or retort after burning-off. One method adopted for ascertaining temperatures in kiln and furnace work consists of using Seger cones. These cones are of varying composition; and they are made by combining alumina and felspar with silicate, to secure different fusing-points. They give a range from 500° to 2000° C., and are numbered for identification purposes. They really represent, however, only a comparative way of testing temperatures. Much depends on the atmosphere in which they are working and the time of heating. They are not absolute indicators of temperature.

Silica bricks are manufactured differently from clay bricks, and have to be bound by the addition of from 1·5 to 2 per cent. of slaked lime. They can be dried more rapidly than clay bricks; but they are more delicate to fire, and more particularly to cool. They have to be fired at a much higher temperature—at Seger cone No. 15 or No. 16, while cone No. 14 is a high temperature for ordinary fire-brick making. If cooled quickly, silica has a great tendency to crack.

Having impressed upon his hearers the importance of the proper mixture of grog and clay, and the necessity for selecting material according to the purpose for which it is intended, the lecturer remarked that the supply of gas is responsible for a large use of refractory material. In proof of this, he exhibited an excellent collection of burner-rings, nozzles, and rods, by Messrs. Ernst Hildebrandt, Limited. Such things used to be made of magnesia; but this is somewhat brittle, and now a very high-class fire-clay is employed. The material is ground fine, and moulded under heavy pressure in machines.

Some very highly refractory materials used in the manufacture of special articles are made from carborundum, alundum, silundum, dynamidon, and diamantin. Fused quartz also is used for fire-radiants and lamp-fittings—more particularly for high-pressure gas lighting. The quartz is fused in an electric furnace, and can be shaped and moulded just like glass. It possesses the peculiar quality that its expansion on heating is practically *nil*—which explains why it can be safely dipped into water when hot.

Presentations to Mr. William Deighton, of Harrogate.

Mr. William Deighton, the Superintendent of the Harrogate Gas Company's Distribution Department, has lately completed fifty years' service with the Company. He began his work with them as an apprentice in the fitting department, served as a lamplighter, as did his father, who himself came to occupy the position which Mr. Deighton now fills, and which he has held for thirty years. Last Tuesday, the Directors of the Company showed their appreciation of his services by presenting him with a solid silver tea service of Georgian pattern, suitably inscribed; and on Friday, at a gathering of the outdoor staff, at which Mr. H. Wilkinson, the Secretary and General Manager, presided, he was asked to accept his portrait in oils. The presentation was made by Mr. Wilkinson, who said the staff offered the portrait as a heartfelt expression of the regard and respect they had for Mr. Deighton; and with this expression he (the speaker) desired to be associated. They wished that Mr. and Mrs. Deighton might have many years of health and happiness, and that the former might be enabled to continue in the honourable position he then held. Mr. Deighton feelingly acknowledged the gift, saying his colleagues could not have presented him with anything that would have given him greater pleasure. During his service with the Company, Mr. Deighton has invented a burner for gas-ovens, a gas-meter index which registers money value as well as the number of cubic feet of gas consumed, a machine for drilling and tapping gas-mains, and an apparatus for heating motor garages and greenhouses.

ENGINEERING AND COMMERCIAL DEPARTMENTS OF A GAS UNDERTAKING:

SUGGESTIONS FOR THEIR CLOSER RELATIONSHIP.

At the last annual meeting of the American Gas Institute, a paper dealing with the above-named subject was submitted by Mr. Clare N. Stannard and Mr. Frank Q. Cannon. It consisted mainly of suggestions received by them in response to requests made to prominent men in the gas industry, not only in the United States, but in Europe, Canada, Mexico, and the East, for information on the question. The requests were generously complied with by nineteen contributors, whose names are given, and whose assistance is duly acknowledged. The main subject was subdivided into "Topics," and the editors have endeavoured to touch the vital points of each.

I.—*How the Commercial Department, Co-Operating with the Engineering Department, can Reduce Installation Costs.*

One of the tasks of any business concern is to minimize the cost of production, operation, &c. In the gas industry, the necessity of keeping installation costs at a minimum is apparent. The actual installation work naturally falls to the engineering department; but the securing and holding of business, which makes such installation work possible, is the work of the commercial department. The men in the two departments should, then, be as conversant as possible with the duties of each. One commercial manager says: "I do not hire any agents who are not practically or technically educated as engineers." Many companies favour the idea of having their engineers spend some time in the commercial department. Such an interchange of knowledge will do much to help both departments.

There are nearly as many ways in which the engineering department, in co-operating with the commercial, may reduce installation costs as there are in the other direction. It is sincerely to be hoped that cases are rare where, in order to get prompt and careful attention, such as the customer is entitled to, orders must be turned over with "prayers and pleadings" of the commercial department in order to get the engineering department to give them proper attention. If such cases exist, a little co-operation on the part of the shop department with the commercial department would have given a prompt and satisfactory job to the customer at a minimum cost to the company. In cases of this kind, a satisfied consumer may well be considered as a part of reduced installation costs.

On the other hand, it is imperative that orders originating in the commercial department shall correctly reach the engineering department, giving time and date when the installation is to be made. It is hardly to be expected that the shop foreman, when he receives such orders as "run pipe," "fix leak," or "adjust burner," with no further information attached, can execute them as economically as if the definite information regarding the installation, which the representative has doubtless obtained through numerous visits to the customer's place of business, had accompanied the order. It is not always convenient for the customer to discontinue temporarily the use of the gas while the installation is being made; thus a fitter and his helper must return at some other time, and a portion of a day's work is lost. At the best, if orders which reach the engineering department are vague, the shop foreman, before he can dispatch his fitters to make the installation, must send a man to obtain the information which might just as well have been furnished him with the order. Rough sketches would serve as a great help; and any commercial man should be able to obtain ample information to take care of ordinary installations.

II.—*Relation of Good Service Provided by the Engineering Department to Securing and Holding Business.*

Volumes could be written on good service as applied to the gas industry; but let it suffice to say that good service does for a gas company what courteous treatment and fair dealing do for a merchant. His customers come back. They tell their friends and neighbours of it, and these people in turn are convinced boosters. Naturally the consumer's idea of good service is not always the company's idea; but the average user of gas is generally fair-minded. Some companies employ men whose prime duty it is to visit the consumer's premises to see that good service is maintained. This means that it is essential that a gas-range just the same as a large industrial installation should give satisfaction to the consumer. Good service may well be counted as an advertising asset; and if it be maintained, the question of cost is more easily dealt with.

III.—*Attitude of the Engineers as Representatives of the Company when Meeting the Public.*

Every employee should remember that he is a representative of the company, and that his attitude towards the public will be construed as the company's attitude. The commercial man gets the business; the engineer is responsible for the service. Let the engineer meet the consumer, and let the consumer know that the company is just as interested in having his business a success as it is in getting its share of business from him. The representative is looking for and creating new business for the company; and any engineer who has the opportunity to do this class of work owes it to the company to do it. It is well to make a point of having the engineer meet prospective as well as actual consumers to discuss with them matters pertaining to business which has a mutual interest for them.

IV.—*Tendency of the Commercial Men to Secure Business at an Excessive Cost from an Engineering Standpoint.*

It happens occasionally that over-energetic or carelessly negligent commercial men, in order to please a consumer or obtain a flattering contract, will agree to do work which will be more expensive than necessary. Most companies avoid this by having many of their charges and rates well defined. Service charges, pipe and fixture contracts, &c., are examples of this; and no commercial man need fail on so simple a proposition. On special work, however, it should be borne in mind by the commercial agents that the taking of an order for a piece of work is not all the story. It has its engineering side also. If the commercial man is not conversant with the engineering details of the job, let him get the opinion of the engineering department before he quotes prices and asks for the consumer's signature to a lease or contract. Many companies have a rule that a piece of business must pay a guaranteed revenue which bears a certain percentage of the total cost of making the installation. This should serve as a guide to both the engineering and commercial departments. On the whole, we would say that the tendency on the part of the commercial man to secure business at excessive cost can largely be overcome by the establishment of definite rates and charges by the company, and by the practical co-operation of the two departments.

V.—*Absolute Dependence of the Commercial Department on the Engineering Department and Vice Versâ.*

It is quite natural that a business organization should be likened to a delicate machine when the inter-dependence of any two departments is to be shown. One defective part in the machine will either put it entirely out of use or will make its work faulty. Just so, one department of the company can set the whole organization awry. Each department is dependent upon the other.

As regards the special dependence of the commercial department on the engineering department, let us first state that any selling organization relies for its existence on the furnishing of a product to sell. Its success depends on the quality of the product; in the case of gas, its purity, uniformity of specific gravity, heat value, pressure, &c. The engineering department must be looked to for the supply of this product and for the prompt correction of faulty service. The speedy execution of orders for the supplying of gas to new consumers converts into facts the promises made by the commercial men; and this conversion is brought about by the engineering department. A knowledge of technical affairs can be most readily obtained from the engineering force; and as the commercial man has daily need of such information, he may well look to the engineer for it.

Some special features of the dependence of the engineering department on the commercial department may be summed up as follows: No producing organization can exist unless its product is disposed of; and naturally a company wishes to increase its output from year to year. Some part of the product of any gas company will be disposed of without any particular selling effort; but a healthy growth requires an aggressive selling propaganda. To quote one of our contributors: "We have evolved from the business of simply making and selling gas to a population which 'must come to the gas company,' and have come to the newly realized idea of a public service corporation having an obligation to the community." An engineering department might exist without a commercial department; but it would either stand still or else grow increasingly weaker if the development work of the commercial department were relaxed.

The commercial department is brought into the active field of competition to a far greater extent than is the engineering department of a non-competing gas company. The stimulation of an aggressive, fighting department extends backwards through the whole company organization, and tends to bring new ideas and new energies into the other departments.

As the commercial department is dependent upon the engineering department for cautions and advice, so the engineering department may well look to the commercial department for suggestions regarding its policy and practice towards the public. Not infrequently, what seems a reasonable and conservative system to the engineer is shown by the commercial man to be against the best interests of the company on account of delaying prompt service, or creating a feeling of suspicion or dissatisfaction on the part of the customer.

In summing up the above topic, perhaps the most important point to be borne in mind is that criticisms and suggestions from one department to the other are earnestly desired, frankly given, and thankfully received. Let us also remember that, if the

commercial department is not active, there will be but a slightly increased demand for the product, and operating costs will not be held down nor decreased. If the engineering department is not alert, the new business will not be taken care of promptly and satisfactorily, which means disappointment to consumers, and consequent loss of revenue to the company.

VI.—*Influence of the Commercial Men upon the Continual Development of Engineering Activities.*

The manufacture and distribution of gas now follow along well-defined lines; but the uses to which it may be put are still in embryo. Each new installation requires engineering skill and attention, and any new use to which gas is applied widens the engineer's field. The commercial man in his daily work discovers new uses for the engineering department's product; so it remains for the engineer to design appliances and do the other technical work which will ensure the efficient operation of the installation. The public is more interested in the developments in the use of gas than we give it credit for. The commercial man can stimulate this interest in his daily conversation with the public, and, as a result, gas will be a serious contender in any fuel or illuminating problems which the prospect may meet.

In general, it goes without saying, not only as regards the engineering department but all other departments, that every member should be more of a booster than is usually the case. The commercial man is usually not afraid to talk shop outside business hours in a more or less conversational manner, which robs it of what might otherwise have an objectionable business flavour.

VII.—*Value of the Commercial Men Learning the Methods of the Engineering Department and Vice Versâ.*

The old maxim: "A jack of all trades is master of none," may have been *à propos* in the day and in the lands where men were, of choice or of necessity, forced to perform but one task. We have such startling examples, however, in the present age of men who have achieved the greatest business successes through their intimate knowledge of every phase of their particular business, that we need not have the slightest trepidation about letting the two departments interchange ideas and knowledge of their methods. Such an interchange would tend to create an estimable and a stimulative rivalry which would have its effect upon the whole organization. If the commercial man gains a knowledge of engineering methods, he can save himself and the engineering department much effort and small detail work, as well as effect a saving in money to the company. The engineer, on the other hand, can, if he is conversant with commercial methods, do much for the consumer while attending to his own work, which might otherwise necessitate extra visits of the commercial men.

VIII.—*Closer Association between the Two Departments.*

We doubt if there is anyone who does not believe that closer association, both in a business and a social way, between the employees of the two departments is a desirable thing. There is no need here to attempt to define the degree of friendship or intimacy to be reached in these social relations. Suffice it to say that the feeling should be strong enough to make it a personal pleasure for one to serve the other. The business relations are more easily defined; and honest business practice will keep these relations as they should be. Cordial relations between department chiefs will engender a spirit of good fellowship among all the department employees.

It is to be expected, where departments are intensely busy, and often working in a state of high tension, that some heavy surges are apt to be started. Here, then, we need some of the old reliable get-together spirit. One department should realize the stress under which the other is working, and due leniency should be shown. Closer association between the two departments will minimize the vexatious small things that are constantly popping up—each too small to cause much trouble, but their bulk calling for prompt action for their removal. One department may be daily doing little things which annoy or hamper other departments. Such conditions are certainly not intentional, and the chief of the offending department would not knowingly permit the needless friction. A ready spirit of investigation should be maintained by each department, and criticisms or complaints which reach them should receive the most careful consideration. In such matters, we must forsake the old-time defensive and aggressive attitudes, and let the co-operative idea take their place. Let us make good use of criticism rather than resent or abuse it, and it will help us to do justice to more than those immediately around us.

IX.—*A More General Interchange of Ideas at Monthly or Quarterly Meetings.*

The frequent coming together of the men employed by the two departments has a twofold value, of affording opportunity for the discussion of questions pertaining to the company's business and for the bettering of the social relation betwen the employees. Just what nature such meetings should assume is, perhaps, a question that each company must work out for its own case. A mixture of the social with the business is employed by many companies; others segregate the two absolutely. If the employees are men who are really interested in their work, and who are anxious to advance, an occasional meeting will not be the vision of a wasted evening. If the interest is there, the meetings can be made a pleasure as well as the source of knowledge. Let the members of one department act the part of the consumer in a discussion with the other department. Many points which are daily met with, and over which many a man has stumbled, will thus be made clear. Information obtained in this way will not easily be forgotten, for each man will realize that the eyes of the men with whom he is competing are upon him. In dealing with the consumer, a commercial man or an engineer often feels secure in making statements about which he is himself not sure; but in discussing such questions with his fellow-employees, he realizes that he is dealing with men who perhaps know more of the subject than he does.

X.—*Influence of the Engineering Department in Laying-out in Advance Extensions which are Later Followed up by the Commercial Men in Securing Business on the Extensions.*

People who are removed from the gas-mains are, as a general rule, interested in the use of gas. It is the old story of people wanting what they have not. Their friends and neighbours use gas and speak highly of it; and naturally they wish to be as up-to-date as others in their neighbourhood. But little information can be given to such a prospective customer when he makes inquiry at the company's office, unless the engineering or commercial department has visited the scene of the possible extension and made a report to the office. If the residents on any such extension see the engineers of the gas company making measurements in the street, and from the street to the houses, their curiosity is immediately aroused. Their interest in the use of gas is increased; and a word dropped here and there by the men of the engineering department, to the effect that "the gas company are trying to accommodate this section with gas," will prepare for the commercial man's approach. If extensions are laid out in advance by the engineering department, the representatives can have maps and figures which will show each house, its distance off the main, &c.; and there can be no chance for the making of rash promises. This businesslike way of handling the subject will appeal to the prospective users, and they will have added confidence in the company and its goods. People will be more willing to listen to the salesman's story if the work antecedent to his visit has been well done.

In this connection, it might be well for locators, foremen, and others in the engineering department whose duties take them to gas-main extensions, to be furnished with prices of gas-ranges, water-heaters, and other gas appliances. Prospective customers could thus know, while they were quite enthusiastic over the idea of using gas, what the appliances would cost them, and orders might be obtained in advance. In small companies, the knowledge of just what appliances a certain extension would require would prove of benefit to the appliance department in the placing of their orders.

XI.—*Feasibility of Combining the Two Departments in One.*

The age in which we live may well be called the age of specialization. True, there are cases of over-specialization, which only go to prove that there are ruts into which any of us may fall. Earlier in this paper we cited the example of the successful men who were conversant with all branches of their business; but we might here add that these men are also specialists in each branch. Reducing the number of working parts is the mechanic's dream. Power losses can thus be minimized. Losses must likewise be minimized in the operation of a business organization; but whether or not the combination of the two departments in one would help the situation, is a question. Two factors enter into the proposition—viz., the cutting of operating expense, and the increasing of the efficiency of the company's organization. If the expense is cut and the standard of efficiency is lowered, nothing has been gained.

The remarkable growth of the gas industry has been due to a combination of engineering and commercial improvements, and each department is entitled to its share of credit. Every company has an engineering department, but not all have commercial branches. A comparison of these two classes will, we believe, show that the commercial department has been a great asset to the companies who have adopted it.

Some companies have tried to combine the two departments by having only trained technical men in the commercial department. But even then the two departments were maintained. Other companies have had just as large a measure of success with commercial men having no special engineering training. The editors feel that a combination of the two departments in one would still leave the commercial and engineering fields to be taken care of; and unless a saving of money or an increase of efficiency could be effected, the consolidation would be useless.

The individual capability of the head of each department, or the capacity of the individual considered as head of the combined departments, might largely influence the question whether or not the two departments should be combined in one. Special cases require special treatment; and it is somewhat difficult to cover in a general way conditions which are to be found in some particular locality.

XII.—*How does Each Department Assist in Giving Good Service, which is the Primary Purpose of the Company?*

Good service is one of the most essential links in the chain of a gas company's operation. Just as a manufacturer must keep the standard of his goods high if he wishes future orders from his customers, so must the service furnished by a gas company be of the highest order. This question of good service embraces, of

course, every phase of the gas company's business; but we shall attempt to define more particularly the good service which is dependent upon the commercial and engineering departments.

Any good service which may be attributed to the commercial department should start at the time our relations with the customer begin—*i.e.*, when application for service is received. If the commercial man will supply accurate and definite information at this time, the customer will not be disappointed in finding things different from what he expects. The commercial man, through frequent visits to the customer's premises, can ascertain just what results are to be obtained by the contemplated installation; and the use of such information by himself and the engineer will assist materially in the correct planning of installations.

Orders emanate from the commercial department, and must be executed as described on the order. This is an additional reason why the commercial and engineering departments should be in perfect accord. Commercial men should at all times be advised in every particular regarding the ability of the engineering department to do work of every nature. The representative makes promises to the consumer as to the time a job will be started and finished, and as to what the installation will do. But it remains for the engineer to carry out these promises. The consumer will not consider that he is receiving good service if the fitters who bring appliances to his home or place of business go about their work in an altogether different manner from that which the commercial man promised.

Perhaps the strongest point that can be made for the assistance which the commercial department may render is that, as a rule, commercial men are better acquainted with the consumer, his business and its relation to the gas business, his installation, and his disposition. In fact, the strongest card that the commercial man holds is his intimate personal acquaintance with the patrons of the gas company. This friendly relation between the commercial man and the consumer permits the representatives to visit the consumer's premises at all times. If there is any defect in the service being rendered to the consumer which is apparent, the commercial man can not only aid good service by either remedying the defect himself or reporting it to the trouble department, but he can at the same time gain the further friendship of the consumer.

If we stop to consider the vast amount of revenue which might easily be lost due to the fact that one small appliance, or even the smallest burner on a gas-range, was not in fit condition to be used by the consumer, we shall see the absolute necessity of the most careful watchfulness on the part of the commercial man. Some companies equip these men with a small kit of tools which enables them to adjust mechanical defects to the service while doing their commercial work. Added expense to the trouble department may thus be minimized.

The engineering department may assist in giving good service by so designing the installation that the possibility of interruption to it will be reduced to a minimum. In most organizations, the engineering department comes less in contact with the customer than the commercial man; and as far as good service is concerned, its duty lies chiefly in planning to avoid trouble. Inasmuch as the trouble department is a part of the engineering branch, the rendering of good service may be accelerated if complaint orders which are brought in by commercial men or by the customers themselves are promptly executed. One gas company we have in mind tries to maintain a five-minute schedule on complaint orders. That is to say, if a customer telephones to the office complaining of a gas leak, poor pressure, or other similar trouble, a man is supposed to reach the premises within five minutes after the call has been received. This high degree of promptness may be more than most of us can attain; but it serves to show the necessity of being keenly alive to the needs of our consumers if good service is to be maintained.

XIII.—*Commercial Men to Spend Some Time in Practical Engineering Work and the Engineers to do the Same in the Commercial Department.*

Unless a commercial man has had the opportunity of a technical education, he must rely wholly upon practical experience and his individual effort and study for a knowledge of the engineering branch of the business. Just so must the engineer whose early training has been entirely technical gain an idea of commercial methods through contact with them. It is a much easier proposition, perhaps, to make a good commercial man of an engineer than to make an engineer of a purely commercial man.

In one of the earlier topics of this paper, we mentioned the fact that some companies whose commercial men had had no particular technical training had achieved just as remarkable success as many companies who insisted that the men should be graduates of technical schools. Most companies are so engrossed in making their business successful and profitable that they cannot afford the time to examine into the question of just how, when, and where their men have gained a knowledge of the gas business. What a company is most interested in is whether the men in its employ are better qualified to do the work which is essential in the running of a successful business than any other men whose services the company could obtain.

Taking for granted, then, that the more conversant a man is with the business of his company the better qualified he is to give value received to the company, we feel that an interchange between the two departments is an advisable thing. It has often happened in the course of a business organization's growth that a man whose duties have been wholly confined to one branch of the business rises to an emergency call, and assumes the responsibility in an altogether different phase of the company's affairs. Investigation in many cases would show that this man, while doing his own work well, had been making himself acquainted with other branches of the business; and so when a crisis came, the man for the place was ready. Any such case, however, requires the most conscientious work on the part of the man attempting it. In the application of the above example to the interchanging of men between the engineering and commercial departments, the idea would scarcely be to make, in a few lessons, engineers of commercial men and *vice versâ;* but the lessons to be learnt by each class of men to make them more efficient in their own departments would be the aim.

Many companies afford an opportunity to college graduates to touch the various phases of the business by offering a practical students' course. Why could not some such plan be devised whereby commercial men could spend an occasional week's time in the fitting department and the other departments which are so closely allied with their work? Commercial men should not be averse to donning the fitters' overalls, and doing the work which they are daily turning over to the engineering department's men to do. Some plan could be formulated whereby engineering men could accompany commercial men in their daily work; thereby learning enough of the commercial methods for them to understand the department's point of view regarding orders which are received by the engineers.

In conclusion, let us state briefly that co-operation is essential, and that every man in a company's employ must realize it and work for it. The company's officers cannot bring it about, nor can the employees alone effect it. Personal feelings and department antagonisms, if there be any, must be forgotten, and one united effort made by both commercial and engineering men.

POWER ECONOMIES IN GAS PLANTS.

This was the subject of a long report presented by a Committee of the American Gas Institute at the recent annual meeting. As mentioned in the communication which appeared in the "JOURNAL" on Oct. 4 (p. 431), it was a complete review of all the factors entering into the economy of steam production and consumption; and its salient features are indicated in the following abstract.

The economical production and utilization of steam has received less attention than any other branch of the gas business, and there are great possibilities of producing saving in the cost of boiler fuel per 1000 cubic feet in the average gas plant. The boiler-room is the vital point of a steam plant; and it may be possible to produce a considerable increase in economy, with little or no initial expenditure, by improving the operating efficiency. Boiler efficiencies of more than 80 per cent. have been obtained; and 70 per cent. or more can be maintained in any well designed and operated plant. The average operating efficiency in America to-day is about 50 per cent.

The selection of the fuel which will give the greatest value per dollar invested is most important. This depends on the location of the plant, its boiler and furnace equipment, and labour conditions. Changes of equipment to suit a more economical fuel may sometimes be advisable, and careful tests may be necessary.

Clean boiler-heating surfaces are essential to economical operation, and various methods of keeping the boilers free from scale must be considered. The surfaces must be kept free from dust, soot, and carbon deposit, by blowing with steam-jets and mechanical cleaning. Feed water must be heated to the highest practicable temperature, preferably by the use of exhaust steam; and the proper type of heater must be selected.

The temperature of the gases escaping from the stack must be reduced to the minimum possible for the steam pressure carried and the capacity at which a boiler is being operated. To accomplish this, heating surfaces must be clean, the boiler must be properly baffled, and the intensity of draught properly regulated.

The grates or stoker must be selected which will best suit operating conditions and the fuels to be used, or these must be changed to suit the grates or stokers. Mechanical stokers will prove more economical than hand-fired grates in many cases, because they reduce the amount of manual labour required in the fire-room, and allow the men to devote more time to maintaining proper furnace conditions. They usually give more smokeless combustion, some reduction in labour cost, and better economy at high ratings; but they are expensive to instal and high in maintenance cost.

Boiler furnaces should be so designed as to give the maximum possible percentage of carbon dioxide, with little or no carbon monoxide in the stack gases. To do this they must provide sufficient combustion space to admit of bringing the volatile gases into intimate contact with the air supplied to the furnace before the gases reach the relatively cool heating surfaces of the boiler. The efficiency of a furnace must be determined by systematic flue gas analysis work. Furnaces which are improperly designed must be changed to give the desired conditions.

Air for combustion may be supplied in three ways, and the proper system to be chosen must be determined for each special case. Forced draught is to be preferred with small size anthracite

coals; but natural draught is usually more economical for bituminous fuels. Forced draught may be preferred whenever it is desired to increase the capacity of the plant. Boilers may often be operated to advantage at much greater capacities than those for which they are designed. But this usually means some loss of economy; and it is not advisable to operate boilers continuously much above their rating.

When considering stack draught problems, it must be remembered that intensity of draught is proportional to the stack height, while the gas capacity is dependent on the stack area. Mistakes are sometimes made in design due to a misunderstanding of the relation between the area and the height of stacks.

The following are the main causes of loss in boiler efficiency and their remedies: (1) Carbonized heating surfaces; cleaning. (2) Scale on heating surfaces; water purification and cleaning. (3) Improper or leaky baffles; change in design or repairs. (4) Poor furnace design; change design or fuel. (5) Improper air distribution to fire; modify draught system or grates. (6) Improper regulation of quantity of air supplied to fire; proper regulation to be determined by flue gas analysis and draught gauges. (7) Leakage of cold air through settings, doors, &c.; test with candle flame, and stop all leaks. (8) Leakage of steam and hot water from boiler and fittings; test for leaks at regular intervals, and stop them as soon as found. (9) Loss of steam by blowing of safety valves; proper regulation of pressure. (10) Loss due to irregular supply of feed water; instal regulators, or force firemen to pay attention to feed regulation. (11) Loss due to radiation; if excessive, cover walls with insulating material. (12) Loss due to sifting of coal through grate; if excessive, decrease size of air openings. (13) Losses due to improper stoking of coal and working of fires; careful training of the firemen as to the best method of handling the coal supplied, and constant supervision of the fire-room force to see that they carry out instructions.

Coal should be accurately weighed if economy of operation is to be maintained. Feed water should also be carefully weighed or measured, and daily records kept of the boiler efficiency obtained. This is especially important in works which operate coal-gas plants or auxiliaries, as in such cases the boiler fuel per 1000 cubic feet may be of little value as an indication of the efficiency of the boiler-plant. Care must be taken to see that weighing devices are accurate and losses are accounted for.

Steam-meters, draught-gauges, pressure-gauges, moisture determinators, pyrometers, and flue-gas analysis instruments are all desirable in boiler plants which are to operate with the best efficiency. Feed-water regulators are of slight economic value, but will correct troubles due to poor hand-feed regulation, and will usually increase the safety of operation. Damper regulators are of doubtful economic value, but are an advantage for accurate pressure control with fluctuating loads.

Most of the steam produced in gas-works is used by the gas machines, by the engines driving various kinds of machinery, by pumps, or in processes auxiliary to the water-gas plant. Water-gas generators often use steam 150 per cent. in excess of the amount theoretically required. It seems probable that this excess can be reduced by improvement in the method of distribution of steam to the fires.

Gas-works machinery may be driven by many types of engines, and the type best suited to the work to be done must be carefully selected. Engines must be regularly inspected, if they are to be kept in condition to operate with the best economy. Certain simple tests will show their internal condition.

Either fan blowers or positive blowers may be chosen for gas-works use; but, as a rule, fans are to be preferred for constant generator conditions, and positive blowers for works which are likely to use different generator fuels and require wide variations of air pressure.

Steam-pumps are usually uneconomical, and must be given constant attention—more especially on the water ends. Some new types of valves and valve-seats have been put on the market which have helped to increase pump efficiency.

Steam supplied to coal-gas plants and auxiliaries should be metered and charged to these processes before wastes can be eliminated. Losses due to steam leakage can be reduced by systematic inspections for leaks.

Exhaust steam is now being used for heating systems in exhaust steam turbines for the production of electric power, and in the process of water-gas manufacture—replacing live steam for this purpose. By collecting and utilizing all available exhaust steam in excess of that needed for heating feed water, it may be possible to effect a considerable saving in live steam consumption. The waste heat from water-gas machines in blast and illuminating gases is being used for the economical production of steam—in this way effecting a large saving in the cost of operating gas-works steam plants.

Royal Society's Awards for Research Work.—We are pleased to find that the Royal Society have awarded a medal to Professor Harold B. Dixon, F.R.S., the President of the Society of British Gas Industries, for his researches in physical chemistry, especially in connection with explosions in gases. The Sylvester Medal has been awarded to Dr. James Whitbread Lee Glaisher, F.R.S., for his mathematical researches. Dr. Glaisher is the son of the late Mr. James Glaisher, who was for some years Chairman of the Barnet and Harrow Gas Companies, of both of which he is a Director.

THE VALUE OF CALORIFIC POWER TO GAS CONSUMERS.

In view of the fact that, in the regulations which are now being considered by both State and Municipal authorities in America for the control of the quality of illuminating gas, prominent place is given to calorific value, and candle-power requirements are either omitted or considered of secondary importance, it occurred to Mr. C. H. Stone, a member of the American Gas Institute, to obtain data as to the proportion of gas used in such a way that its heating power alone was of significance. He accordingly conducted an investigation in Middletown (N.Y.), and communicated the results in a paper at the recent annual meeting.

The plan adopted was to let an employee call upon every customer of the Gas Company, and, upon slips prepared for the purpose, to enter the number, kind, and size of burners in each room separately, as well as the make, size, &c., of every gas-stove, water-heater, radiator, and iron or other appliance using gas. He did not enter a house as one seeking information. His instructions were to adjust every burner that needed attention; to note any complaints (save as to the size of bills); to give advice when so requested; to instruct in the most economical methods of cooking and lighting; and to report to the office any needed repairs or adjustments that would require more of his time than could be spared for such work. The result of this canvass, from the Company's standpoint, was threefold. First, it created a most friendly feeling among a large number of consumers, who felt, and so expressed themselves, that the Company were really trying to give them the best possible service. Secondly, it started the use of a large number of burners and appliances which had been temporarily laid aside because they did not give satisfaction, and had greatly lessened the work of the complaint department. Thirdly, it furnished the Company with a full list of those who needed ranges, heaters, burners, &c., so that the salesman could approach the proper parties with full certainty that they ought to want a range or water-heater, whether they did or not.

The slips thus secured were studied one by one, and an entry made on a large table, which showed whether the party had a range, a water-heater, a radiator, or other heating device, and then left three columns: (1) Percentage of lighting in mantle burners; (2) ditto of total gas used for cooking or heating; (3) ditto of gas used in such a way that its heating value only was required. On the accuracy with which the three columns were calculated depended the success of the investigation. The author explained the method adopted. The filling-in of the last column, or the percentage of gas used in such a way that its heating value only was required, was a matter of simple arithmetic. For example, if 60 per cent. of the total gas was used for cooking, and 60 per cent. of the lighting gas was employed in mantles, it was clear that 84 per cent. (or 60 per cent. + 60 per cent. of 40) was used for its calorific value.

The three columns were then averaged, and the whole table dissected and summarized as follows:

Total number of consumers represented	1139
Number of—	
Gas-ranges	621
Combination ranges	62
Hot-plates	338
Water-heaters	195
Irons, radiators, and other heating appliances	182
Consumers using no gas for lighting	524
Consumers using no gas for heating or cooking	60
Consumers using 90 per cent. or more of lighting gas in mantles	308
Consumers using 70 to 90 per cent. of lighting gas in mantles	93
Consumers using 50 to 70 per cent. of lighting gas in mantles	92
Consumers using from 1 to 50 per cent. of lighting gas in mantles	52
Consumers using none of their lighting gas in mantles	67
Consumers using all their gas so that the calorific value only is of value	746
Percentage of gas used for cooking or heating	69
Percentage of lighting gas used in mantles	55
Percentage of gas so used that the calorific value only is of value	83

The author said these figures spoke for themselves; but to express some of them in another way might, he thought, add to their significance. Of all the consumers, 46 per cent. used gas only for cooking or for heat; 65 per cent. used all their gas in such a way that they cared only for its heating value; and only 6 per cent. used no lighting gas in mantles, and only 5 per cent. used no gas for cooking or heating.

The author concluded by saying that the whole investigation led inevitably to four conclusions: (1) The open-flame burner is fast disappearing. (2) The greater part of gas used to-day is consumed in ranges and heating appliances. (3) The calorific power of the gas is therefore the most important test of its value to the consumer. (4) A candle-power standard may benefit those using 10 per cent. of the gas distributed, but it does so at the expense of, and with actual damage to, those using the other 90 per cent. It was earnestly hoped that such facts as these might be of assistance in leading to the abolition of the photometric standard.

OIL AND TAR FOR POWER PURPOSES.

An account by Professor E. J. Constam, the Director of, and Dr. P. Schläpfer, the Assistant at, the Fuel Testing Laboratory of the Federal Technical College of Zürich, of investigations they have carried out on oils for use as fuel in the Diesel type of engine has appeared in the "Zeitschrift des Vereines deutscher Ingenieure" for Sept. 20, Oct. 4, 11, 18, and 25 last. The investigations are of a particularly exhaustive character, and the information collected is likely to be of value generally in regard to oils of the type stated, which include those suitable for gas making, and tar oils, as well as other types of fuel oils and various kinds of tar. The following is a summary of the contents of the communication.

Kutzbach has distinguished fuel oils which are suitable for use in internal combustion engines as motor oils, to which expression power oils has been suggested as an alternative. The oils first used in Diesel engines were chiefly spirit-freed and crude petroleums, gas oils, petroleum residues, and brown coal or lignite oils from various sources. Then coal tar distillates, and even crude coal tar, were used. Technical literature contains but little exhaustive information on these oils regarded as fuels. Many of them had been investigated at different places in different ways, and the results were not comparable. The authors therefore undertook an exhaustive examination of a large number of different motor oils of which the origin and behaviour in Diesel engines was known, and of others which were tested specially for this research in the works of Sulzer Bros. The chemical and physical properties of the oils investigated can therefore be compared with their behaviour in the Diesel engine.

Rieppel had, in 1908, published the results of the examination of a large number of motor oils; but none of the oils examined by him contained mechanical impurities. He formed the opinion that brown coal or lignite tar oils could be used in the Diesel engines, but coal tar oils could not be employed without some preparation. He judged the suitability of an oil from its specific gravity, viscosity, flashing point, and calorific value. The factor of chief importance, however, was the proportion of hydrogen in the oil, from which he deduced the presence or absence of fatty or aromatic hydrocarbons. The self-ignition and combustion of the oil took place more certainly the greater the yield of oil-gas from the oil at comparatively low pressures and low temperatures.

Other authors have adopted Rieppel's conclusions; but some of them have shown that coal tar oils were applicable in Diesel engines. Graefe considered the calorific value as the most important property of oils; while those which were thinner or more freely fluid were preferable, other things being equal. Rath and Rossenbeck drew up a specification for coal-tar oils for use in modern Diesel engines which embraced the following provisions: The oils must not contain more than 0·2 per cent. of solid matter insoluble in xylol, or more than 0·05 per cent. of incombustible matter, or more than 1 per cent. of water, or more than 3 per cent. of residue on coking. At least 60 per cent. by volume of the oil must distil over below 300° C. The net calorific power must be not less than 15,840 B.Th.U. per lb.; the flashing point must not be below 149° Fahr.; and the oil must be quite fluid at 59° Fahr. The Roumanian Section of the International Petroleum Commission has published a specification for Roumanian gas and motor oils, of which the authors give a translation. Allner has investigated the use of tar as fuel in Diesel engines. [See "Journal," Vol. CXV., p. 106].

Method of Examination.

The examination of different oils by the authors included the following points—viz.

1.—Determination of specific gravity by weighing at 59° Fahr.

2.—The behaviour of the oils when cooled for one hour to temperatures of 32° Fahr. and 5° Fahr. respectively.

3.—The determination of the flashing-point by the Pensky-Martens close-test apparatus, and of the ignition point (open test) by heating in an open crucible on a sand bath and applying a small gas-flame to the upper surface of the oil at each 5° C. rise of temperature. Comparative testings show no consistent relationship between these two determinations. The flashing point determination is untrustworthy in the case of oils containing water.

4.—Self-ignition temperature. Rieppel holds that there is no relation between the flashing point or ignition temperature of the oil and its ignition in the engine, because the latter is determined solely by its chemical nature. The authors made experiments to see if dropping the oil into a closed crucible heated to a known temperature would give the self-ignition temperature at atmospheric pressure, and whether this would bear a direct relation to its ignition in the engine. The arrangement of one platinum crucible inside another, with the intervening space filled with powdered quartz, and provided with an asbestos cover through which passed a platinum-rhodium thermo-element for measuring the temperature and a gas outlet tube, as used by the authors, is described in detail. A slow stream of dried oxygen or air was passed through the crucible, and a drop of the oil or tar to be tested was allowed to fall in at a certain temperature, which was afterwards increased or lowered until the exact temperature of self-ignition had been found. Some experiments were made with nickel and porcelain crucibles of the same size, in order to ascertain whether the self-ignition temperature was affected by the material of the crucible.

5.—Determination of the viscosity by Engler's viscosimeter, 1911 pattern, at 20°, 35°, 50°, 75°, and 100° Cent.

6.—The boiling or distillation test: An Engler flask with drawn-out neck was used for petroleums, lignite tars, and vegetable oils, and a benzol fractionating flask for other tars and tar oils.

7.—Determination of the water content by Schläpfer's method, which consists in mixing 100 grammes of the oil or tar with 200 c.c. of xylol in an Erlenmeyer beaker, and distilling the mixture until 150 c.c. have been collected in a measuring vessel, the lower end of which is drawn out and provided with a scale graduated in 0·05 c.c. divisions. The measuring vessel is suspended in a cylinder of hot water, and drops of water hanging to the walls are touched with a glass rod until the xylol is clear. After cooling, the volume of water collected is read off. Blank tests must be made to determine the constant loss.

8.—Determination of the ash by taking about 50 grammes of the oil or tar in a platinum scoop, igniting, burning over a small flame, and afterwards strongly igniting.

9.—Determination of the calorific power by means of a bomb calorimeter.

10.—Elementary analysis, for which the samples of oil were weighed off in sealed vessels.

11.—Determination of sulphur, which was made on the products of the calorific test in the bomb.

12.—Determination of the residue on coking in a platinum crucible according to the method recommended by the German Tar Products Association.

13.—Determination of the asphalt in petroleum and lignite tar oils, as matter insoluble in ether-alcohol.

14.—Determination of the free carbon in coal-tar oils and tars by Kohler's method. The so-called "free carbon" thus determined is not pure carbon, as the following analyses of two samples show:—

	Sample 1. Per Cent.		Sample 2. Per Cent.
Carbon	92·7	..	91·6
Hydrogen	2·6	..	2·6
Oxygen and nitrogen	4·0	..	5·1
Sulphur	0·7	..	0·7
	100·0		100·0

15.—Determination of the naphthalene in tars, by freezing out from the fraction distilling between 150° and 230° C.;

16.—Determination of the mechanical impurities in oils by agitating 25 to 100 grammes of the oil with two to three times its quantity of toluol, and filtering through a filter, previously dried at 105° C., and weighed in a weighing bottle. The filter containing the deposit was well washed with toluol, followed by alcohol, and after drying at 105° C., again weighed in the weighing bottle.

Results of the Investigations.

Petroleum, lignite tar, and vegetable oils consist chiefly of aliphatic bodies, whereas coal-tar oils and tars have a preponderance of bodies of the aromatic series. The aliphatic bodies ignite far more readily than the aromatic; and the authors arrange motor oils into two classes according to this distinction. They give tables showing the results of the examination of 109 samples of petroleum, 8 samples of lignite and shale oils, 2 vegetable oils, 29 samples of coal tar oils, and 74 samples of tars. These tables give for each oil or tar: The specific gravity at 59° Fahr., the behaviour on cooling, the flashing point (close and open test), ignition temperature, fractionation results, proportion of water and ash (if any) in the oil, calorific power, elementary composition, yield of coke and proportion of asphalt, mechanical impurities, free carbon, and naphthalene present.

Petroleum.

Of the 109 samples of petroleum examined, 41 were of Galician origin, for the reason that the bulk of the oil used in Diesel engines in Switzerland comes from Galicia. The Galician oils were mostly of the gas-oil grade, and their specific gravity varied from ·853 to ·890, and in most samples solid paraffin settled out between + 5° C. and − 5° C. At the ordinary temperature the viscosity was low, the flashing-point (close-test) was generally over 90° C., and the self-ignition temperature in a platinum crucible in a stream of oxygen was about 350° C. Fractionation showed that most of the Galician motor oils were crude oils from which the petrol had been removed, or heavy distillates. The residue on distillation was small, and very little coke was produced. The calorific power was high.

There were 18 samples of German petroleums—all but one being from Pechelbronn, in Alsace. Some were not motor oils, but were examined for comparative purposes in regard to the general properties of these oils. They are, generally speaking, less good than the Galician oils.

Thirteen samples of Roumanian oils were examined; mostly high boiling oil residues of high viscosity and of lower calorific power than the Galician oils. Four samples of Russian oil were examined, which, generally speaking, were of higher grade than the Roumanian oils. The North American oils examined comprised seven samples, three of which were normal gas oils free from highly volatile constituents; while a Texas refuse oil, a Texas liquid fuel, and a Californian crude oil were all heavy

viscous oils containing mineral matter, and the Californian oil in particular was unsuitable for use as a motor oil. A Californian residual oil, on the other hand, was of better quality. Six samples of Mexican oil were examined, of which three were gas oils and the remainder crude oils. The latter contained much asphalt, and were of high viscosity. The Mexican oils contained a large proportion of sulphur, and their calorific power was low; but the gas oils, notwithstanding their high proportion of sulphur, seem suitable for use in Diesel engines. Five samples of oils from South America were examined—three being crude oils from the Argentine, one a crude oil from Patagonia, and one a power oil from Peru. The latter contained highly volatile constituents, involving a high fire risk. The remaining South American oils were heavy, and several samples contained a large quantity of water, which was very difficult of separation.

Nine samples of oil from the East Indies and Japan were examined. They were mostly heavy oils of low calorific power. Five samples of oil of unknown origin were also examined; one being a gas oil mixed with naphthalene.

The brown coal or lignite tar and shale oils were chiefly of German origin, though one sample of Scotch crude oil was examined. It had a comparatively low calorific power. The two samples of vegetable oil examined were a nut oil and an African palm oil. Both were of low calorific power.

The Galician oils generally appear from the results to be the best for motor purposes; but the authors point out that in Switzerland they had the best opportunity of obtaining these oils, and that from other countries they did not always obtain the best grades.

The authors next report on the behaviour of the petroleum oils (referred to above) in the Diesel engine. The engine tests show broadly that any petroleum or petroleum product which is not too readily ignitable, and which has a net calorific power of at least 18,000 B.Th.U. per lb., and contains neither asphalt nor mechanical impurities, can be used as a Diesel motor oil in all circumstances. It is not suggested that petroleums having other properties are unusable; but the mode of working the engine must with such other oils be adapted to the particular oil. In any case, oils not coming within the above specification cannot be readily used with small engines. Chemical and physical tests of an oil will, however, indicate how it should be used. Oils which deposit solid matter at a comparatively high temperature, and have a high viscosity, must be heated before use; oils which, on distillation or coking, leave considerable quantities of black residue, or contain much asphalt, will readily cause hard deposits in the engine. In such cases, it is helpful to raise the temperature of combustion by increasing the compression and injection pressure.

Coal-Tar Oils.

The coal-tar oils which come on the market as motor oils are mixtures of the two naphthalene oil fractions of tar, from which most of the naphthalene has been removed, with anthracene oil. They are also used as impregnating and fuel oils. For motor purposes they must contain as little anthracene and its homologues as possible. They are distinguished from petroleum and lignite oils in that they consist of aromatic compounds which are split up with difficulty—a fact which is shown both by their elementary composition and their calorific power. The self-ignition temperature, as determined by the authors, is about 200° C. higher than with petroleum; being about 550° C. The tar oils for motor purposes examined by the authors had chemical and physical properties falling within the range shown in Table I.

Table I.—*Range of Variation of Coal Tar Motor Oils.*

Specific gravity at 15° C.	1·006 —	1·110
Flashing point, close test, degrees Centigrade.	66 —	121
,, ,, open test, ,, ,,	84 —	160
Self-ignition temperature in ,, ,, platinum crucible and current of oxygen	about 550	
Fractionation—		
Light oil, 0—170° C., per cent. by vol.	0 —	12
Middle ,, 170—230° C. ,, ,,	0 —	80
Heavy ,, 230—270° C. ,, ,,	1·0 —	36·0
Anthracene ,, 270—350° C. ,, ,,	9 —	66·5
Residue above 350° C. ,, ,,	1 —	34·5
Water, per cent.	0 —	1·82
Ash, ,,	0 —	0·04
Calorific power, net, B.Th.U. per lb.	15,921 —	16,425
Carbon in the oil proper, per cent.	87·1 —	91·4
Hydrogen ,, ,, ,, ,,	6·0 —	7·8
Oxygen and nitrogen ,, ,,	1.4 —	4·9
Sulphur ,, ,, ,, ,,	0·4 —	0·9
Hydrogen in excess of the oxygen for formation of water, per 100 parts of carbon	6·2 —	8·3
Yield of coke, per cent.	0·4 —	3·6
Free carbon and mechanical impurities, per ct.	0·0 —	0·2
Naphthalene, per cent.	0·8 —	10·5

Some of the creosote oils contained much ash, consisting of ferric oxide. This renders them unsuitable for use in Diesel engines, although it is less deleterious than the ash of coal tar, which consists chiefly of silicates. The fundamental difference between coal-tar oils and petroleum and lignite tar oils is, in the authors' view, that the coal-tar oils must undergo thorough decomposition before they ignite, whereas petroleum oils, &c., burn as soon as their vapours are ignited. This conclusion is borne out by the determinations of self-ignition temperature in the crucible, and by the fact that tar oils and tars frequently give hard carbon deposits in the cylinder and exhaust, owing to the slow combustion of the carbon liberated on decomposition. Coal-tar oils answer better in slow-running large engines than in rapid-running small engines; also, engines cannot be started up from the cold with tar oils. Generally, therefore, the engine is started with petroleum or a lignite tar oil, and when it has become hot, the ignition oil is only used for initiating combustion, and the coal-tar oil answers as the motor-oil. With large engines in continuous running at full load, coal-tar oil alone may be used. Tar oils which contain a larger proportion of high boiling constituents (such as anthracene oil) than is prescribed by the specification of the German Tar Products Association for Diesel engine oil, do not generally behave so well in the Diesel engine. Unfiltered anthracene oil cannot be recommended, because it must be heated to at least 60° C. in order to keep it fluid. Generally speaking, tar oils which comply with the specification of the German Tar Products Association answer well in large Diesel engines running without very great fluctuations of load. An advantage of all coal-tar oils is their relatively low viscosity.

Tars.

Only a few grades of tar, containing comparatively little free carbon, can be utilized in the Diesel engine. In order, therefore, to elucidate the different behaviour of tars as motor fuel, the authors examined 74 samples of tars of different origin, and tables are given of the analytical results. The tars examined fall into three classes—viz.: (1) Coal tars, comprising (*a*) horizontal retort tars, (*b*) inclined retort tars, (*c*) vertical retort tars, (*d*) large chamber tars, (*e*) coke-oven tars; (2) water gas and oil gas tars; (3) sundry other tars. The limits of variation of the analytical results for each class of tars are given in Table II.

In regard to the different classes of tars, that from horizontal

Table II.—*Range of Variation of Tars.*

Nature of Tar.	Horizontal Retort.	Inclined Retort.	Vertical Retort.		Large Carbonizing Chamber.	Coke Oven.	Water Gas.	Oil Gas.
			Dessau.	Woodall-Duckham.				
No. of samples	9	8	11	4	4	12	15	3
Specific gravity of crude tar, at 15° C.	1·156–1·235	1·125–1·157	1·057–1·123	1·081–1·101	1·064–1 089	1·140–1·182	0·968–1·129	1·051–1·069
Flashing-point, close test. Degrees C.	67– 92	52– 78	49– 75	41–52	35–71	90–135	34–91	18–69
,, ,, open test. ,, ,,	93–129	79–107	70–102	71–90	70–93	108–166	50–about 155	20–89
Self-ignition temperature in platinum crucible and current of oxygen. Degrees C.	520–630	490–520	510–530	500–510	480–510	about 600	..	about 560
Fractionation—								
Light oil, 0–170° C. (P.ct. by vol. of tar exclusive of water and ash)	1·0– 6·6	1·5– 6·7	1·0–9·3	3·0– 8·4	2·5–10·0	0·0– 0·0	1·0–12·0	2·5–23·0
Middle oil, 170–230° C.	10·2–14·0	14·7–17·8	16·0–24·0	13·0–16·9	21·0–24·0	1·0–17·0	6·0–23·0	11·0–16·0
Heavy oil, 230–270° C.	8·5–13·0	4·9–14·4	8·8–18·0	11·2–13·0	9·5–12·5	6·5–14·0	11·2–24·5	11·0–19·0
Anthracene oil, 270–350° C.	9·9–21·9	12·9–21·0	19·2–24·5	19·5–21·0	17·5–24·0	19·0–27·5	19·3–51·4	18·0–31·0
Residue (pitch)	51·7–66·5	47·6–54·7	31·5–47·0	44·0–51·0	39·0–41·5	50·0–65·0	18·6–51·3	31·5–37·0
Yield of coke from pitch, per cent.	32–47	32–40	16–27	20–25	21–22	16–34	25–39	33
Composition of crude tar—								
Water, per cent.	0·00–8·72	1·11–7·30	0·77–3·63	1·11–2·84	1·29–5·82	0·59–6·67	0·00–36·65	0·32–10·31
Ash, ,, ,,	0·00–0·06	0·01–0·07	0·00–0·09	0·00–0·03	0·00–0·00	0·04–0 36	0·00– 0·67	0·00– 0·21
Calorific power of dehydrated tar, net, B.Th.U. per lb.	15,745–15,887	15,790–15,952	15,898–16,335	15,912–16,020	15,826–16,025	15,793–16,049	16,177–17,271	16,355–16,819
Elementary composition of tar exclusive of water and ash—								
Carbon per cent.	90·4–92·9	89·3–90·4	87·6–89·9	87·9–88·8	87·1–89·3	89·6–92·2	89·3–93·0	91·4–92·2
Hydrogen ,, ,,	4·7– 5·5	5·9– 6·4	6·0– 7·3	6·6– 7·2	6·7– 7·1	5·1– 5 7	5·5– 9·2	6·3– 7·2
Oxygen and nitrogen ,, ,,	1·7– 3·2	3·2– 3·9	2·6– 4·9	4·1– 4·7	3·6– 5·2	2·2– 4·0	0·4– 1·7	0·5– 1·1
Sulphur ,, ,,	0·5– 1·0	0·4– 0·7	0·4– 0·6	0·5– 0·9	0·3– 0·6	0·4– 1·2	0·6– 1·0	0·4– 0·9
Hydrogen in excess of the oxygen for water, per 100 parts of carbon.	0·18– 5·7	6·0– 6·6	6·1– 7·7	6·8– 7·5	6·9– 7·4	5·2– 5·9	5·8–10 1	6·6– 7·7
Yield of coke, per cent.	15·1 –33·3	15·3–21·7	4·0–10·8	7·0– 9·7	7·1– 7·3	7·6–16·9	3·1–11·4	7·6–11·3
Free carbon ,, ,,	9·3 –27·6	10·0–19·3	1·1– 5·7	3·1– 5·7	2·3– 3·0	2·2–10·3	0·0– 4·0	0·0– 4·1
Naphthalene ,, ,,	4·1 – 6·0	1·2– 3·3	0·2– 2·5	0·1– 1·0	0·6– 2·1	0·5– 9·8	0·3–10 0	0·0– 3·1

retorts has a very high viscosity, and its flashing point is higher than that of vertical retort and chamber tars, because the latter contain more volatile constituents. It also has the highest ignition temperature, and yields the largest proportion of pitch on fractionation. The coke yield from the free carbon in horizontal retort tar is also higher than in vertical and large chamber tars. Almost all the tars examined contained mineral matter derived from the material of the retorts or settings. This mineral matter is, on account of its hardness, specially harmful to the pistons and valves of Diesel engines. The free carbon and naphthalene are higher, and the heat of combustion is lower, with horizontal retort tar than with other coal tars. The nine samples examined came from Lucerne, Bâle, Stuttgart, Mülheim, Budapest, Monaco, San Paulo, and Freiburg.

Inclined retort tars have properties lying broadly between those of horizontal and vertical retort tars. The eight samples examined all came from Swiss Gas-Works.

Vertical retort and large chamber tars have already been used as motor oils, and are distinguished from horizontal and inclined retort tars by their lighter colour, their lower specific gravity, and their lower viscosity. They yield less pitch, and the pitch yields less coke. The proportion of hydrogen in them is higher, and, consequently, they have a higher calorific value than the other coal tars. The eleven samples of Dessau retort tar came from the Berne and Zürich Gas-works, and from a Mülheim firm; the four samples of Woodall-Duckham tar from the Lausanne Gas-Works; and the four samples of chamber tars from Leipzig, Munich, Innsbruck, and Hanau.

Coke-oven tars are distinguished by the fact that the more readily volatile constituents have been previously removed in the benzol-washing process. They are black, highly viscous, and of high specific gravity. The flashing point and ignition temperature are also higher than with gas tars. Their composition, however, varies greatly according to the class of coal and type of oven used. The twelve samples examined were from German coke ovens.

Water-gas and oil-gas tars are decomposition products from petroleums, or lignite, or shale oils, used in gas manufacture. Owing to the great differences in the methods of gasification, they range in character from tar resembling coal tar to one having properties similar to the gas oils used. The water-gas tars, which consist partly of unchanged gas oil and contain but little free carbon and naphthalene, have a high calorific power, and are clearly suitable for use as motor oils. Some water-gas tars, however, contain not less than 10 per cent. of naphthalene, and otherwise approach in character coal tar. Water-gas tars frequently contain a large proportion of water. Their viscosity is lower than that of coal tars, and consequently they lend themselves well to centrifugal treatment for dehydration and the removal of free carbon and ash. After such treatment, these tars are quite well adapted for Diesel engines. The fifteen samples of water-gas tar examined were obtained from the Lausanne, St. Gall, Bâle, Geneva, Brussels, Buda-Pest, and West Amsterdam Gas-Works. Five samples of tar from Bohemian brown coal or lignite were examined, and showed wide variations according to the method of carbonization followed. Blast-furnace, gas-engine, peat-gas, and other tars were not examined, because they are unsuitable for power purposes on account of their large proportion of mechanical impurities.

One instance of the use of inclined-retort tar in Diesel engines is known to the authors, in which a 750-H.P. engine works continuously at full load on this tar. Prolonged trials have been made with several vertical-retort tars, but there is no case known to the authors of continuous working in varying conditions with them. Nevertheless, it may be concluded from their properties that, when they contain little water and ash, and are of low viscosity, both vertical-retort and chamber-setting tars may be satisfactorily used as motor oils. Two of the samples of coke-oven tar are known to be used in Diesel engines, with the addition of an ignition oil and after previous heating to reduce their viscosity. One of the oil-gas tars was tested in the trial engine, and worked well when the injection pressure was increased.

Generally speaking, tars, whatever their origin, are better suited for use in Diesel engines the lower their content of water, ash, coke, and free carbon, and the more freely fluid they are. Unburnt particles of tar settling on the relatively cool walls of the cylinder are, however, liable to contaminate the lubricating oil and render it unserviceable. Owing to the wide variations in tar, even from the same source, and to the tolerably uniform composition of the tar oils obtained by distillation and filtration, the authors consider these oils much preferable to tar itself as a fuel for Diesel engines. Tars for use as motor oils must in any case have the following qualities—viz., the merest traces of ash, not more than 3 per cent. of water, not more than 3 per cent. of free carbon, and a net calorific power of at least 15,480 B.Th.U. per lb.

Viscosity of Motor Oils.

Since certain crude oils which otherwise would be good motor oils are unsuitable on account of their high viscosity, the authors made comparative tests of the viscosity at different temperatures of a large number of the samples of oil examined. The viscosities found for the temperatures 20°, 35°, 50°, 75°, and 100° C. are stated in a table given in the original paper in Engler degrees. The Galician petroleums, the brown coal or lignite oils, and the coal-tar oils have low viscosities—viz., less than 3° Engler at 20° C. Some of the crude petroleums have viscosities at 20° C. as high as 300° and 400° Engler, while horizontal-retort tars range from 42·7° to 150° Engler at 20° C., and from 3·88° to 25·6° Engler at 50° C. Inclined-retort tars have viscosities ranging from 23·4° to 114·7° Engler at 20° C., and from 3·65° to 8·60° Engler at 50° C. Dessau vertical-retort tars showed viscosities ranging from 2·5° to 32·8° Engler at 20° C., and from 1·51° to 3·79° Engler at 50° C. One sample from the hydraulic main had a viscosity of 51·9° Engler at 20° C. Two samples of Woodall-Duckham retort tar had viscosities of 32·6° and 40° Engler at 20° C., and 2·7° and 3·5° Engler at 50° C. Tar from large carbonizing chambers ranged from 7·96° to 13·46° Engler at 20° C., and from 2·02° to 2·45° Engler at 50° C. Coke-oven tars were more highly vicious, and only a few were tested at 20° C. Eight samples had viscosities ranging from 6·8° to 38·4° Engler at 50° C. Water-gas and oil-gas tars ranged from 1·52° to 4·35° Engler at 20° C., and from 1·15° to 1·88° Engler at 50° C. Oils which show a high viscosity at 50° C. must be fairly strongly heated before use in the Diesel engine. It is very important that oils which deposit solid matter on cooling, as certain petroleum oils do, should have pipe lines and connections duly protected from cold.

Self-Ignition Temperature.

The temperatures of self-ignition, as determined in a platinum crucible and a current of oxygen and air by the authors, are set out in a table for a large number of oils. The results show a considerable difference between petroleum and lignite tar oils, which ignite readily in the engine, and the coal tars and tar oils, which ignite with difficulty. In the current of oxygen the smaller differences disappear, and only the differences which are characteristic of the various classes of oils persist. Ignition temperatures observed in a nickel crucible agree fairly well with those observed in a platinum crucible; but a porcelain crucible gives higher readings, and its use is therefore not recommended by the authors. Holm has lately published observations of the ignition temperature of oils made by a different method. He found the self-ignition temperature of petroleum gas oils to be 350° C., which agrees with the figure found by the authors for the platinum crucible in a current of oxygen; and Holm found for coal tar oils 580° C., against 550° C. found by the authors, and for coal tar 500° C., against 480° to 530° C. found by the authors. The authors' temperatures for the platinum crucible with a current of air instead of oxygen were higher than those for the latter. The results probably do not justify any conclusion, beyond that they show similar differences between the various classes of oils which are found with those oils when ignited in the Diesel engine under high pressure.

Conclusions.

The authors summarize the results of the work which they have carried out as follows: Oils regarded from the standpoint of applicability in Diesel engines may be divided into three classes—viz: (1) Standard motor oils generally applicable, which may be safely used in all engines and at any load; (2) oils which may be used with special arrangements; and (3) oils which are unsuitable.

The first class includes petroleums or gas oils from which the lighter constituents have been removed, and petroleum distillates and lignite tar oils. Both should contain over 10 per cent. of hydrogen and be free from mechanical impurities, and the net calorific power of the petroleums should be over 18,000 B.Th.U. per lb., and of the lignite tar oils over 17,460 B.Th.U. per lb.

The second class includes coal-tar oils, vertical retort and large chamber tars, water-gas and oil-gas tars, certain coke-oven tars, and certain crude petroleums. The coal-tar oils should contain less than 1 per cent. of water, less than 0·05 per cent. of ash, less than 0·3 per cent. of mechanical impurities (including free carbon), yield less than 3 per cent. of residue on coking, and have a net calorific power of not less than 15,840 B.Th.U. per lb. The other tars mentioned should contain less than 3 per cent. of water, less than 0·05 per cent. of ash, less than 3 per cent. of free carbon, and have a calorific power of not less 15,480 B.Th.U. per lb. The crude petroleums must all of them be judged separately on their merits.

The third class comprises horizontal and inclined retort tars. It is not implied that in certain conditions none of these can be utilized in the Diesel engine, but as a whole they are not applicable in it.

A Naphthalene and Tar Solvent.—According to the "American Gaslight Journal," the Tennessee Mining and Manufacturing Company, of Nashville, are making "Little-ene"—the trade mark for a solvent to remove obstructions from pipe-lines and apparatus. It is claimed that this material, placed in a washer or scrubber, picks up automatically the naphthalene in the gas, and carries it forward to the burner. The combined vapour, when in the washer and on passing along with the balance of the gas, is picked up and made into a permanent gas by the natural heat of the main portion. The gas, passing through the washing liquor, picks up exactly the amount of solvent necessary to keep the naphthalene permanently suspended; the operation being entirely automatic. In addition, it acts as a solvent for solid naphthalene or thick tar; and it acts immediately when applied directly to a main or service choked with naphthalene. It is stated that the trouble, delay, and expense of opening-up and cleaning a clogged rotary washer or a tower scrubber are entirely done away with. By absorbing and carrying forward, in gaseous form, the naphthalene which usually deposits on the oxide in the purifiers, all back-pressure in the boxes is prevented.

PROTECTION OF STREET MAINS BY AN ADEQUATE SYSTEM OF INSPECTION.

THIS subject was dealt with in a paper submitted by Mr. C. C. SIMPSON, jun., at the annual meeting of the American Gas Institute. The author is the Assistant General Superintendent of Mains of the Consolidated Gas Company of New York. The following are the principal portions of the communication.

STREET PATROLLING OR LINE-WALKING.

For a number of years it has been the practice in New York City to patrol and inspect each street and avenue daily. This work requires a force of approximately thirty patrolmen and three chief patrolmen, each having assigned to him a regular district, and having a regular route laid out for covering it. The men start at one end of their route at 7 a.m. and finish at about 4 p.m.; thus allowing sufficient time to go to the branch office and make a report of the day's work. The principal duty of a patrolman is the reporting of gas leaks. These, of course, are telephoned immediately to the nearest station, and the emergency crew is sent out to investigate. As a general proposition, however, the patrolman is required to report to the branch office every item of interest or value to the Company. During the period from Jan. 1 to Dec. 31, 1912, these men reported 7590 important items. The system costs a considerable amount of money in wages; but it is not difficult to demonstrate that this is expended wisely and well. Each of these 7590 reports represents approximately a cost of $3; but is it not worth this sum to be in a position properly to protect our property before the occurrence of any damage?

Let us analyze the work of these patrolmen during the year in question. First, we have street leaks of all characters, of which a total of 642 were reported. Second in point of importance we have reports of depressions in the pavement, which, in New York City at any rate, always indicate the possibility of serious disturbance of mains and services. There were 166 cases of this character reported. Another very important duty of the patrolmen is that of reporting buildings about to be taken down. There were 806 reports of this character. Still another duty is the reporting of excavations made by other companies, in which it is, or may become, necessary to protect our structures properly; for contractors and many subsurface corporations are notoriously and criminally careless with respect to the proper support and protection of gas-mains which they encounter. The balance of the 176 patrolmen's reports consisted of miscellaneous items, such as drip and valve boxes above or below grade, which might cause accidents to vehicles or pedestrians; meter and house-pipe leaks, which were reported to the patrolmen by citizens, janitors, &c. As already stated, the patrolmen have their own districts, and they soon become known to the residents as well as to the workmen of other companies. Their very presence among the other workmen undoubtedly prevents considerable damage to the Gas Company's property. As an incentive to diligence on the part of the patrolmen, every six months a tabulation is made of the reports they have sent in (which, of course, have been checked by the branch office), and the patrolman in each branch having the highest rating for the period receives an increase in pay.

RAPID TRANSIT SUBWAY WORK.

Probably the most dangerous class of work, so far as gas companies are concerned, now being undertaken in some of the larger American cities is the construction of underground railroads; and in this respect a vast deal has been learnt by bitter experience during the past ten years. The practice of gas companies where work of this character is being, or has been, conducted is at present so nearly standardized, that a description of the methods employed for insuring absolute safety in New York will serve to cover the ground thoroughly.

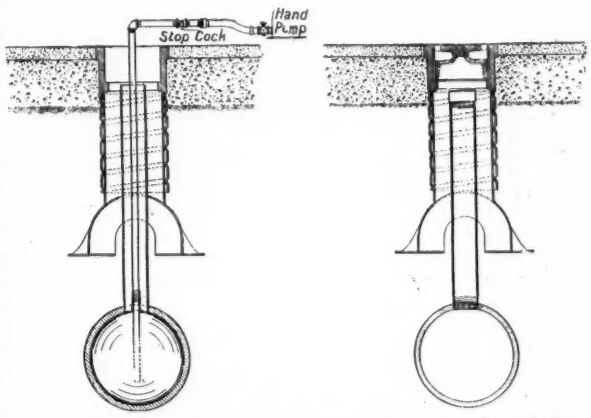
This work was commenced in 1901; but at that time it was done mostly by the "open-cut" method. The general clamour, however, against traffic and business disturbances caused by this type of construction has resulted in recent years in the prosecution of the work by the "cut-and-cover" method, which, so far as subsurface gas property is concerned, is infinitely more dangerous. The "open-cut" method, as its name implies, consists of opening the entire street from the surface, and merely decking over a small portion of it for vehicular and passenger traffic. While this allows of considerable serious damage to gas-mains if extreme vigilance is not maintained, the danger of serious explosions is greatly reduced, as the cut is naturally well ventilated. The "cut-and-cover" method, now in general use in the more congested portions of cities, consists in first removing the street paving, and then replacing it with a tight wooden decking, under which the excavation and construction progress, practically by tunnelling methods. It does not require great imaginative power to figure how disastrous an explosion could occur were a gas-main to be broken, or even to leak for a short period of time, in this beautifully constructed explosion chamber.

Before any excavation is made, temporary bye-pass mains are laid along the street decking, and carried back into the side streets to a point of safety. As soon as the services have been transferred to the bye-passes, the mains in the street are immediately cut off and capped. Most of the contractors engaged in building subways in New York City consider this protection work so important, that they are unwilling to assume the risk of excavating until the bye-passes have been installed. In addition to these temporary bye-passes, it is necessary to take care of all the larger mains which are interfered with in any way by subway work. This is done by carrying large mains on trestles. These lines are laid in addition to the regular kerb bye-passes, and are placed overhead so as not to interfere with street traffic. Valves are provided at intervals, in order that any section of the mains may be quickly shut-down in case of necessity.

So much for the precautions taken before the work is started. But we dare not permit our vigilance to stop here. Every foot of street or avenue where subway work is in progress is constantly patrolled, day and night, by specially trained uniformed inspectors. They have each a section, approximately half-a-mile long, and on each section there is a tool-box containing all the necessary tools, wrenches, stoppers, &c., which might be needed in case of emergency. They are required to ring time-clocks at each end of their section at short intervals, and are in charge of foreman inspectors on each shift, and still further under the supervision of a general subway inspection foreman. This subway work is now deemed to be so important, that the position of Subway Engineer has been created, with one of our best distribution engineers placed directly in charge; and under the present method the work has been in progress for nearly two years at the date of writing without a single disturbance to our property. We have endeavoured to make the system as nearly "fool-proof" as possible, and apparently have succeeded.

SPECIAL INSPECTION ON OTHER THAN SUBWAY WORK.

As before stated, in New York the regular patrolmen send in daily a list of all street openings on their routes made by others than the Gas Company; and these locations are turned over to the various district foremen, who inspect them and report to their district superintendent on the advisability of assigning special inspectors. Wherever conditions warrant it, a competent gas man is placed on the work, or on several different jobs if they are located within a short distance of each other, to ensure that no damage is done to our subsurface property. These inspectors are provided with all necessary tools and appliances, so that in the event of the occurrence of damage they are able immediately to take such steps as may be necessary to prevent trouble and interruption of service. The presence of these special inspectors is of great benefit to us. Before it became the policy to assign them on all street openings, it was quite common to find our mains built into manholes, or having other heavy subsurface structures resting upon them. Where blasting operations are in progress in sufficiently close proximity to our structures to be liable to cause damage, stopper-holes are always tapped in the mains; and before each blast the inspector inserts the stoppers, so that in the event of a break no great amount of damage can be done.



Stopper in Place. Arrangement of Stand-Pipe.

A Surface Inserted Gas-Main Stopper.

Another class of construction work which, though it does not directly affect the street surface to any great extent, requires constant vigilance, and to which these special inspectors are assigned, is that of excavation for building foundations. For work of this character, we have recently developed what we call, for want of a better name, a "surface inserted stopper." This is merely an ordinary gas-bag with a long pipe-stem, and it is inserted through a stand-pipe which has been previously brought to the surface, and is protected by an ordinary street-box. The accompanying diagrams will show more clearly than any description the method of using this device, which is of considerable value, allowing as it does of the repaving of the street surface as soon as the stand-pipe has been placed, and rendering unnecessary the construction and maintenance of a temporary wooden manhole. The street boxes over these stand-pipes have a special distinguishing cover,

which enables them to be readily located. Another benefit derived from this type of stopper is that when the stand-pipes are once placed in the main they are there to stay, and may be used at any time later as temporary valves.

With regard to the damage caused to underground structures by improperly secured building excavations, I was considerably amused by an item in a British gas publication describing an occurrence of this character which resulted in the breaking of three mains. It was stated that "the first man arrived at 1.30 a.m., and the final stopper was inserted at 8.30 a.m., stopping all escape of gas;" and the article closed with the statement: "The dangerous work was successfully carried out without an explosion occurring, without the gas firing, and without injury to anyone." If our British friends had expended £5 or £10 in taking some of the precautions I have previously described, the final stopper could probably have been inserted five minutes (instead of five hours) after the occurrence of the accident, and at least an enormous waste of gas would have been prevented.

Inspection and Patrol of High-Pressure Mains.

High-pressure mains are of a somewhat different character from low-pressure ones, inasmuch as breaks in the main are considerably more likely to be found than a number of small leaks, and these breaks, owing to the large volume of gas escaping, are ordinarily detected at once and reported by citizens.

The Western United Gas and Electric Company patrol their entire high-pressure system twice every year—once in the autumn, before the cold weather; and again in the spring, after the frost has left the ground. In addition to these periodic inspections, the Company also patrol different sections of their lines from time to time when breaks are suspected. The latter patrols are not so thorough as those in the spring and autumn, as they are made only in the event of a break, and are confined to its discovery. In the period inspections, a certain number of men who are familiar with the mains are required to walk over the streets in which the mains are laid, paying special attention to any indication of leakage either from smell or from dead vegetation. The patrolmen also examine all culverts and drains which are crossed by the mains; and organized leakage work by barring is done when the aggregate amount of all the small leaks appears to warrant it. Many of the towns supplied by the Company at high pressure are under the control of reducing regulators, which maintain a constant pressure of from 8 to 10 lbs. At the outlet of these regulators, connections are provided for a Westinghouse high-pressure meter; and once a year a test is made by connecting this meter at the hour of minimum consumption. After an experience of some fourteen years, the Company consider patrolling as described of sufficient importance and value to be systematically carried out.

In Chicago, streets containing high-pressure feeder lines are patrolled twice a week, and the feeder-line vaults and the valve-basins are constantly inspected by a special vault inspection crew, equipped with a motor car. The Detroit City Gas Company patrol the streets containing high-pressure mains once a year—usually late in the autumn. This work consists ordinarily of an examination of surface evidences of leaks, such as partially destroyed grass and trees, or the presence of gas in the manholes of other subsurface conductors. Where evidences of leakage appear frequent, organized barring over the affected district is usually resorted to.

HANDLING, STORING, AND SALE OF COKE.

This was the subject of a long paper, full of illustrations, read at the last meeting of the American Gas Institute by Mr. J. W. Schaeffer, the Superintendent of the Milwaukee (Wis.) Coke and Gas Company.

In his introductory remarks, the author emphasized the fact that coke is difficult to handle properly, and that, unless it is well handled and intelligently sold, the extension of its sphere of use and the widening of its market become serious problems, as success in these only follows much painstaking educational work in the fuel markets, and is seldom due to a spontaneous demand. The great movement to coal-gas manufacture is making available for sale a constantly and rapidly increasing tonnage of coke, the disposition of which depends not so largely upon the existence of a demand as it does upon excellent quality and live, honest, and intelligent salesmanship. The lack of demand for coke in a community where other fuels are freely used is no indication that a substantial volume of business cannot be developed.

Successful coke marketing is contingent upon carrying out the following programme: (1) Chemical analysis of coke must be such as to best suit it to the purpose intended. (2) Physical structure must fulfil requirements. (3) The coke should be bright and silvery. (4) It must be dry as possible. (5) It must be properly handled. (6) It must be uniformly of the proper size for the purpose intended. (7) It must be delivered in packages acceptable to the trade. (8) An economic advantage in its use must be demonstrated. (9) Contact between the producer and consumer being through the salesman, it must be positive at all times.

Passing over the first two items, the author remarked that while silvery coke is made in the quenching, the best quenching practice fails to brighten a spongy, green coke. The silvery appearance does not add any intrinsic value to the product, but it assists in dispelling the prejudice of the novice in its use, whether he be a consumer of domestic or of metallurgic coke. If coke is of the right quality to start with, the silvery appearance will result from prompt and proper quenching. Mr. Schaeffer gave a description of the quenching method adopted at Milwaukee, where the plant produces 1800 tons of coke daily in bye-product ovens, having a capacity of 7¼ tons per oven. The coke from each oven is discharged into a 40-feet car having a sloping bottom, and being self-propelled by two electric motors. The water is applied at the rate of 2000 gallons in 1 min. 50 secs.—the actual time required for quenching.

Passing from quenching to the subsequent handling operations, the author pointed out that the fragile property of coke should be carefully reckoned with. Well-designed plant should handle coke with minimum breakage. The main elements entering into handling plants are conveyors, crushers, and screens; and the types to be employed depend upon local conditions. At Milwaukee, belt conveyors, fluted roll crushers, and rotary screens are used; also bars for the separation of foundry coke from the under-sized kind. The author inclines strongly to belt conveyors, because of the delicacy with which coke can be handled upon them, and because of their reliability, due to the absence of intricate mechanical devices. With regard to crushers, it is doubtful whether there are any better adapted to coke work than those of the fluted roll type, which should be so arranged that the distance between the rolls can be quickly adjusted throughout a considerable range, and all the adjustments properly fixed. In the author's opinion, flat screens of the shaking or vibratory type do not generally agitate the coke sufficiently to make them altogether satisfactory. [The author here gave a series of illustrations showing the coke-handling plant at Milwaukee.]

On the subject of the storing of coke, the author said the best advice that could be given was that storing should be avoided if possible. Production of "fines," absorption of water, and consequent difficulty in rescreening, freezing in winter, less attractive appearance, and high cost are some of the chief disadvantages attending its storage. The hygroscopic property of coke is, of course, conceded—not fully understood. The quality of the coke undoubtedly exerts a great influence, and because of its variation, the determination of the quantity of water which it is possible for it to absorb from the atmosphere under extreme humidity conditions becomes somewhat difficult. On account of the serious disadvantages named in storing coke outdoors, it would seem that those who store domestic coke regularly should estimate seriously and carefully the economic advantage of putting it under cover. Foundry coke should not be stored at all; but if absolutely necessary to do so, proper protection against the elements should be provided.

Coming to the sale of coke, the author said that in most respects it was no different from that of any other commodity; for it was always necessary first to have a suitable product to market, and then to promote a mutually profitable sale. The greatest opportunities for development lie in the domestic fuel markets. The use of coke for domestic purposes is in its infancy, with anthracite as the chief competitor. Direct educational advertising with the consumer and descriptive matter distributed through dealers have been found to yield very good results. In Milwaukee, experts are employed in order to demonstrate the merits of coke for domestic use. Its uses for manufacturing purposes are so diversified that classifications of them should be carefully tabulated and sales should be made in a systematic manner, from class to class. A successful sale in one plant of a particular line of manufacture should easily pave the way for sales in others. Experience has taught that the more carefully the classifications have been made and followed, the easier has been the promotion of sales.

A PORTABLE ELECTRIC PHOTOMETRICAL STANDAND.

At the last Meeting of the American Gas Institute, Mr. A. H. Schaaf described a portable electric photometrical standard.

He pointed out that flame standards have been used exclusively for the photometry of gas, owing to the fact that they are affected by the atmospheric humidity; and as the electric lamp is not so affected, it has been practically abandoned for this purpose. He thought there was no reason, however, why, when corrected, it should not give results that are more accurate and consistent than those obtained by the use of flame standards. By correcting for humidity in the way to be described, a standard had been produced which had proved itself a worthy competitor of flame standards. It is very compact, and can be readily mounted on any gas-photometer. The instrument does not require the attention of two observers, as the current, when carefully adjusted, will remain so for the ten minutes of the test. The standard was designed by Dr. Clayton H. Sharp, of the Electrical Testing Laboratories, who gave a description of it.

The correction for humidity has been based on the formula recommended by the United States Bureau of Standards for the correction of the pentane lamp:

$$I = I_n\,[1 - 0{\cdot}00567\,(e - 8) + 0{\cdot}0006\,(b - 760)]$$

Where I is the measured candle power in international candles under given atmospheric conditions; I_n, the value of the lamp

under standard conditions—*i.e.*, 8 litres of water vapour per cubic metre of dry air and a barometric pressure of 760 millimetres; e, the number of litres of water vapour; and b, the barometric pressure in millimetres. In using the lamp uncorrected for humidity, the formula becomes:

$$I = I_n \left[1 + 0{\cdot}0006\ (b - 760)\right]$$

In order that the results with the electric lamp should agree with those of the pentane lamp, they must be changed 0·567 per cent. for each litre of water vapour above or below 8. It has been found very convenient to consider the value of the electric lamp to vary rather than to make an additional correction at the end of the test.

The efficiency of the standard may be judged from the following comparisons. Those in the first set were made by the author by the substitution method, and include a large variation in atmospheric humidity; those in the second set were made on the same gas with two different photometers; and those in the third set with standard candles.

First Set.

Pentane Lamp.		Electric Standard.		Pentane Lamp.		Electric Standard.
24·48	..	24·32		23·06	..	22·80
22·63	..	22 61		23·98	..	24·29
22·93	..	23·11				
22·40	..	22·40	Average .	23·25	..	23·25

Second Set.

Pentane Lamp.		Electric Standard.		Pentane Lamp.		Electric Standard.
23 94	..	23·10		22·14	..	23·48
24·23	..	23·33		23·38	..	22·63
23·84	..	24·11		23·19	..	23·09
23·65	..	23·04		23·45	..	23·90
22·65	..	23·50		22·51	..	23·97
23·02	..	24·45		23·21	..	23·19
Average . 23·56	..	23·59	Average .	22·98	..	23·38

Third Set.

Pentane Lamp.	Electric Standard.	Pentane Lamp.	Electric Standard.	Pentane Lamp.	Electric Standard.
23·07	22·81	24·44	24·07	22·41	22·46
22·74	23·46	22·61	23·12	22·63	23·01
23·32	24·01	22·00	22·14	23·25	22·51
24·72	24·79	23·11	23·16	22·84	22·94
23·61	23·72	22·86	22·64	22·93	22·53
23·14	23·54	22·04	22·53	22·74	23·01
Aver. 23·43	23·72	Aver. 22·84	22 94	Aver. 22·80	22·74

These comparisons represent tests selected at random from three or four months' testing, and show the performance of the electric standard as compared with the open flames. Comparisons of the second set were taken at three different works by the works' chemists; the individual tests being taken on different days. In the third set, the first two averages are those of two consecutive months; the individual tests being taken on different days. The third average represents similar comparisons at another works; the individual tests being, as before, taken on different days.

The author arrived at the following conclusions: The electric standard possesses many advantages. First, its cost is about 2 c. per day, including depreciation, which is very low when compared with candles or the pentane lamp. Secondly, it is easily operated, and no time is lost in heating-up, as is the case with candles or the pentane lamp. The electric lamp can be kept burning very low, and so the coils in the bridge will be heated and ready for test at all times. Thirdly, it cannot be thrown out of adjustment when handled properly. The lamps can be restandardized when so desired, and in burning a 1¼ watt tungsten lamp at a gas colour, which is about 3 watts per candle power, there is very little chance for the lamp changing. If this standard were universally adopted, there would be little trouble in regard to candle power in the future.

Distillation of Coal at Low Pressure and Temperature.

According to a paragraph from the Paris Correspondent of the "Chemical News," which appears under the heading of "The Scientific Week" in their current number, M. Pictet and M. Bouvier, of Geneva, have lately made a series of interesting experiments on the distillation of coal at low pressure and temperature. He states that by distilling coal *in vacuo*, without exceeding 450° C., these two *savants* have collected a cold condensed liquid (1·5 per cent. of the weight of the coal) and a tar (4 per cent.), and no ammonia. This tar, called "vacuum tar," is very different from ordinary tar. It is light brown, and does not contain any phenol, but merely bases. After washing with alkali and acids, if it is made to undergo another distillation, slightly fluorescent liquids appear, and then products of turpine and menthol. The oxidation of these products only gives acids of an oily nature. In these tars neither naphthalene nor anthracene, nor indeed any aromatic body, is found. If this vacuum tar is passed through a red-hot tube, there will appear: (1) Lighting gas; (2) a strongly ammoniacal substance; (3) ordinary tar, charged with phenol, benzene, and anthracene. The pyrogenous distillation of coal is then made in two operations; and the formation of the latter products is preceded by the formation of vacuum tar.

STEEL AND WROUGHT-IRON MAINS AND PIPES.

The subject of the installation of mains and pipe-lines of steel and wrought-iron was brought under the notice of the members of the American Gas Institute at their annual meeting by Mr. H. L. Rice, the General Manager of the Western United Gas and Electric Company of Aurora (Ill.). The following is an abstract of the paper.

Choice of Pipe.

The author began by pointing out that in the choice of pipe for mains and pipe-lines the conditions to be considered are suitability, first cost of material, and expense of installation and management. He expressed the opinion that cast-iron pipe is not suitable for high-pressure work, for pressures exceeding 5 lbs., nor for low-pressure work in sizes under 4 inches, first because of its porosity and the uncertainty of the joints, and secondly because of its brittleness. Screw-joint pipe of wrought iron or steel, owing to its shorter life, is particularly less suitable than cast iron in certain locations.

This pipe is frequently cheaper than cast iron in the smaller sizes; and the possibility thus exists that it may profitably displace cast iron for low-pressure work in the following cases: (1) Where pipe smaller than 4 inches is sufficient for the locality with the usual reasonable provision for the future; (2) where the first cost of 4-inch or larger pipe is less than that of cast iron; (3) where, in small organizations, it can be laid and maintained cheaper, better, and more readily, because of the absence of a regular crew skilled in, and equipped for, laying cast-iron pipe; and (4) where special elements of depreciation are anticipated, such as the condition where the future development of a locality is doubtful, and long life of pipe is of less consequence than present service at lowest first cost. The case for steel or wrought-iron pipe may be stated thus: In high-pressure systems, it is the only suitable pipe for pressures above 5 lbs. In low-pressure systems, use will be found for it continually for 2-inch and 3-inch mains, when these sizes are indicated as proper for permanent need or for some desired temporary service; occasionally for 4-inch mains during periods of high priced cast-iron pipe, or in organizations not equipped for laying and maintaining cast iron at reasonable cost; and seldom for 6-inch mains under the same conditions.

In the choice of screw-joint main pipe, as between wrought iron and steel, the gas engineer meets the same problem that has confronted him for years in his service-pipes, with the additional qualification that tensile strength is an important consideration in pipe-line work. The effect of expansion and contraction is especially severe on long screw-joint pipe-lines which frequently stretch for many miles without bends. It is now well known that expansion sleeves at intervals are but a doubtful safeguard; and two large companies are known to lay all their pipe-lines without their use. The Western United Gas and Electric Company laid 9 miles of 8-inch line in 1910 without sleeves to test this proposition. Two breaks occurred in the first year; in both cases the line pulled apart in the body of a valve, separating 2 inches. The valves and fittings were then protected by sleeves; and one more break followed—this time in a coupling. Two years have since passed without any additional breaks. This breakage is no more severe than has occurred in other lines of this Company laid with sleeves. Thus on 18 miles of 8-inch pipe, laid in 1912, with expansion sleeves every 800 feet, there have been two breaks caused by pulling apart—one at a valve and the other at a coupling. The practice of the Company originally was to instal an expansion sleeve every 500 feet; and at present they are placing them every 1000 feet. This practice is based on the conclusion that sleeve protection, unless sleeves are used at nearly every joint, is only partially dependable, and that safety must be sought principally in the strength of pipe and fittings; but that the entire elimination of sleeves is not desirable, as their presence in the line at reasonable intervals is convenient in its maintenance.

Physical Conditions of the Two Metals.

The author inserted in his paper some observations on the comparative physical conditions of wrought-iron and mild-steel pipe, by Mr. E. R. Mason, of the National Tube Company, who stated that improvements in manufacture had removed objections to the modern pipe material until the superiority of steel pipe in welding, bending, and threading had been firmly established. The only important difference of opinion now existing regarding pipe was as to corrosion. As the result of several years' investigation in the laboratory and the field, the Company six years ago decided to discontinue entirely the manufacture of wrought-iron pipe. He gave examples of wrought-iron and steel pipes which showed that, compared by measuring the depth of pitting below the original surface of the metal, there was no practical difference in the results of corrosion. The attention of the members was directed to a paper read before the Institute in 1908, containing the results of some underground tests of pipe, The conclusion arrived at was that "the pitting on the steel pipe is probably more general all over the surface; but the pitting in the wrought-iron pipe is deeper in the spots that are affected." Mr. Mason said this was interesting, in view of the fact that special mechanical working of the metal is done in his Company's mills, with the idea of securing uniform corrosion rather than pitting. He added that the result of this test, that from the view-point of corrosion there was little

to choose between wrought-iron and steel pipe, was interesting, as indicating mild-steel pipe to be as durable as wrought-iron pipe in underground work—a point which has been substantiated under many other conditions of service.

Relative Corrosion.

The author did not consider it within the scope of his paper to take a decided stand on the question of the relative corrosion of the two kinds of pipe. But in order that the presentation of the subject might be entirely unprejudiced, he gave some remarks contributed by Mr. E. A. Moore, of the A. M. Byers Company. This gentleman said:

Assuming equal care in manufacture, wrought iron has the advantage. . . . Its cost of production is governed very largely by labour; and while improvements have been made in methods of manufacture, the cost has not been reduced in the same proportion as has been possible in the steel process; and we now find a difference of about 30 per cent. in the price of wrought iron and steel. In view of this difference, increasing recognition of wrought iron is in itself proof that, after the test of long service, which is admittedly the only reliable one, genuine wrought iron has proved itself to be far superior to steel in its resistance to corrosion and in its machining qualities. Genuine wrought iron is made by the hand-puddling process from straight pig iron without the admixture of any steel or so-called wrought-iron scrap whatever, and has proved, in actual service, to be more than 300 per cent. longer lived than steel; showing that the slightly increased first cost is of no importance compared with the additional length of life in service.

Coatings and Coverings.

Dealing next with this subject, the author said: On account of the well-established fact that steel and wrought-iron pipes are more susceptible to corrosive action than those of cast iron, they are dependent for their maximum efficiency in underground service upon the use of a suitable protective coating or covering properly applied. Corrosion in underground pipe systems may be traced to either or both of two primary causes—the chemical action of the soil, and electrolytic action from stray currents; and the success of the protective agent will depend on its ability to resist the particular conditions to which it is exposed.

Pipe for use within a limited distribution area is usually coated at a central point where heat is available. When the dipping method is used, the bath should be hot, and the pipe should remain in it until it has acquired the temperature of the bath. When the painting method is employed, both the pipe and the paint should be hot. Before coating, the pipe surface must be rubbed or brushed clean of mill-scale and rust. Carelessness in this respect is responsible for many quick failures of coatings. If rust is heavy, a coat of rust-removing oil should be applied before cleaning. The coated pipe must be carefully piled, with each length isolated by the use of vertical and horizontal separating strips. For unusually severe electrolytic conditions, heavily pitching the pipe in a V-shaped trough is of especial value. In pipe-line work, where the pipe is received at many outlying points, and transportation is difficult at best, coating on the job is generally to be preferred. In such cases, a portable or traction boiler is a valuable addition to the equipment.

Main-Laying—A Trench-Digger.

The author said it would not be necessary for him to give details of the actual laying of wrought-iron and steel mains, as this had been dealt with in a paper by Mr. Walton Forstall. He would, however, direct attention to certain variations in organization, equipment, and other matters caused by the use of a different character of material. These matters occupied the next portions of his paper. In this connection, he gave particulars of a trench-digging machine now in use on pipe-line work under his supervision. It was purchased last spring, at a cost of $5000, and immediately set to work to dig a continuous stretch of thirty miles. It is of the endless chain bucket type, and is driven by a 25 H.P. four-cylinder water cooled gasoline engine. Its dimensions are: Length, 36 feet from end to end when the boom is out of the ground for road travel or on car; width over all, 8 feet; height, 12 feet; wheel base, 13 feet. Its total weight is rather more than 12 tons. It cuts a trench 18 inches, 22 inches, 24 inches, or 28 inches wide, and of any depth up to 10 feet, at a graduated speed of from 1 to 5 feet per minute, depending upon the width and depth required and the nature of the soil. The dirt is thrown by a conveyor to either side of the road; and by using the deflector provided, it can be deposited within one foot of the edge of the ditch. It has a road speed of two to three miles per hour when moving from one job to another; and it can be easily loaded on to a flat car under its own power, when desired for transportation to distant points. Between May 10 and May 24 last, the machine operated over a total distance of 11,808 feet in eleven actual working days, at a total cost of $120·36, or 1073 feet per day at 1·02c. per foot. This cost includes the operator and assistant, the board bill of the operator, some teaming, gasoline, lubricants, and a few minor repairs; but it does not include the wages and board of the operator during four rainy days, which bring the cost up to 1·15c. per foot. This digging was done through a very wet sticky clay, some gravel with a few rocks, roots of trees, &c. The ditch was made 24 inches wide and 4 feet deep. The ground conditions were favourable to the extent that little blocking was required. The author considered the advantages of machines of this character—viz., low cost per foot, simplified organization, and freedom to a large extent from labour troubles—were so manifest as to ensure their increased use on work of this description.

Mr. Rice next dealt successively with the subjects of trenching and laying, fittings, valves and valve systems, reducing governors, &c., and concluded by offering some remarks on

Extra Large Steel Mains.

Beginning with the 8-inch size, he said that steel pipe is manufactured in more than one weight; and in the larger sizes there is much choice in this respect for the pipe-line builder. In addition to what is strictly known as "pipe," there are also grades of tubing and casing in which the thickness and weight are still further reduced. Casing is also manufactured in small diameters and many sizes. Much large pipe lighter than the standard weight is safe to lay with screw joints. The lighter weights of 8 and 10 inches are often chosen for pipe-lines, and laid in this way. From 10 inches upwards, however, practice favours the use of plain-end pipe jointed entirely with couplings of the Dresser type. This construction is generally found cheaper and safer in large diameter pipe work; and there is, of course, no option where the lighter weights of tubing or casing are used. But he added that for extended experience along these lines it was necessary to go to natural gas practice, in which pipe of the character mentioned has been mostly used; and though these special weights and methods of construction were of growing interest in gas engineers' practice, extended discussion of them was beyond the scope of his paper.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Testing of Gas-Fire Radiant Efficiencies.

Sir,—I had no intention of intervening again in this discussion; but in view of your leader of the 11th inst., I feel constrained to make the following observations on the matter, in order to make my own position clear.

With regard to the Leeds test for radiant efficiencies, you seem to take up the curious position that, because it demands "great care in manipulation and conditions," the time has come for its revision. May I ask whether you would advocate the substitution of some other method that shall not require care in application? If so, then you are apparently ignorant of the many precautions which must be taken to ensure even tolerable accuracy in heat measurements of this kind.

But if you think there is a real case for "some agreed-upon revision of the test," the onus surely lies with you, or those whose views you voice, to prove—in a manner satisfactory to physicists—just where the present method fails in point of either accuracy or convenience. And then, assuming that a good case is made out, the required revision ought to be undertaken by experienced physicists as a purely scientific problem, without reference to gas-fire politics. It is not a matter that can be negotiated with the man in the street, or even with gas-fire makers' technical staffs; nor, if I may be permitted to say so, would the task of revision be much helped by weekly editorial interventions.

The Leeds method (as I have already explained) originated in a conference which I had, on behalf of the Committee, with Professor William Stroud, whose judgment in regard to physical measurements could hardly, I suppose, be impugned even by your favourite "authority," Mr. W. J. Atkinson Butterfield. After deliberately rejecting the idea of a purely calorimetric method, as being subject to somewhat large errors for which no proper correction could be applied, Professor Stroud expressed his preference for the calorimeter-*cum*-thermopile method, which was ultimately adopted. And, I may add, his judgment has been confirmed by more than one eminent physicist whom I have privately consulted on the matter.

The Leeds method may not be immaculate; no one has ever suggested that it is. It may, as you say, require "care in manipulation;" but it would be a very poor method indeed that did not. It undoubtedly takes time; although I can vouch that an experienced worker can easily make three or four separate tests per diem. But it is much less subject to error than a purely calorimetric method; and, unlike the latter, it gives, besides an approximate measure of the total hemispherical radiation emitted by a fire, what is equally important, a reliable and very valuable indication of the radiation distribution. But perhaps it is just because of the last-named merit that the present agitation for its revision has arisen.

If a more accurate and equally convenient and informing method can be devised, I for one should welcome it. Indeed, in conjunction with Professor H. L. Callendar and Mr. H. James Yates, I am engaged upon the investigation of the possible application of an independent bolometric method, as a means of checking or standardizing the other; and we hope in due course to have some interesting new data to publish in the scientific journals. But, if a new alternative method is forthcoming (no matter from whatever quarter it may come), I for one shall want to be convinced of its all-round superiority over the old; for it would be foolish to relinquish the old except upon definitely proven grounds.

It is not my intention to discuss the matter with Mr. Butterfield; but when he talks in cryptic language about some newly-discovered "important factor in connection with the Leeds test" relating to "room temperature," I wish your readers to know that a blank test is (or should be) always applied, to determine the heat lost or gained by the radiometer when it is effectually screened from direct radiation from the fire, and a "correction" applied accordingly. Needless to say, such a "correction" has always been applied in all the determinations made by me.

Finally, I wish to point out that I have never at any time given

expression to the opinion that it is not possible to construct a gas-fire which shall pass all its products of combustion through the flue-vent without the aid of a chimney draught, and yet not suffer any appreciable diminution of its radiant efficiency when subjected to chimney draught. All that I have said is that a particular construction of fire—namely, one in which the bottom of the canopy extended downwards until it was almost level with the top of the radiants—does not fulfil this condition; and to this opinion I still adhere.

Moreover, the results that were published in Mr. Hartley's lecture [Tables VII. and VIII. on p. 516 of your last issue], to which I would direct your readers' attention, confirm my views. Mr. Hartley shows that, whereas in the case of a fire in which the distance between the bottom edge of the canopy and the top of the fuels was 4¾ inches, the radiant efficiency was practically unaffected by an increase in chimney draught (a circumstance which I can confirm from my own experience), yet in the case of another fire, in which the distance was 2½ inches only, there was a distinct falling off in radiant efficiency with increasing draught. Had he gone further and tested a third fire, in which the distance was reduced (say) to ½-inch, he would have found that the diminishing effect of increasing draught upon radiant efficiency would have been still more marked.

It stands to reason (and it can be proved by experiment beyond all shadow of doubt) that if a fire be so constructed that a large excess of ventilating air is drawn in over the upper portion of the radiants, thereby cooling them, its radiant efficiency must diminish with increasing draught. To argue the contrary, as you have persistently done throughout this controversy, is to maintain one or other of two equally absurd propositions—namely, either (1) that a hot surface is not cooled by the passage of cold air over it, or (2) that, although so cooled the radiation emitted by the surface is not thereby diminished. This dilemma is the *reductio ad absurdum* of your whole argument.

WILLIAM A. BONE.

South Kensington, S.W., Nov. 14, 1913.

[This communication is dealt with in our editorial columns to-day.—ED. J.G.L.]

Outlying Village Supply and Tight Pipe-Joints.

SIR,—I am sorry if my somewhat jerky utterances on Mr. Valon's paper were not as clear as they might have been, in speaking of the costs of open-lead, screwed, and welded joints. It may be that welded joints are a little dearer than the others in first cost; but in the long run the welded joint has no rival—it is not only the best for twenty-four hours, but the best for all time and all circumstances.

In regard to leakage which you refer to in your editorial, Mr. Valon's figure of 1½ per cent. over his whole district and my figure of 8 per cent. are not comparable. Mr. Valon's average pressure is a few inches; my average pressure is more than a few pounds. Further, I believe that the bulk of my leakage is in the low-pressure, not in the high-pressure, mains. A leakage of 40 cubic feet per mile per hour per year for 28 miles of main having 5500 connections to it with a pressure of 30-10ths day and night on 14 miles of it, and a pressure of 5 lbs. to 15 lbs. per square inch on 14 miles of it, is, I think, a fairly satisfactory result.

With reference to the first cost, as well as the ultimate cost, of joints, and their respective values. There are 8760 hours in a year, 5280 feet in a mile; so that, with pipes 18 feet long, there are 293 joints per mile. A leakage of one-tenth of a foot per hour per joint would represent 29 cubic feet per hour per mile, or 257,000 cubic feet per year per mile. A leakage of one-tenth of a foot per joint is a quantity that is most difficult to detect. It would not light unless issuing from one small orifice; and it would take a very good test indeed to show it. The question I would ask is, what sum are we justified in spending on any joint which leaks to the extent of only one-tenth of a foot per hour to eliminate the leakage. The answer is that a joint leaking one-tenth of a foot per hour costs in a year, with gas at 1s. per 1000 cubic feet, 8¾d.—say, 7s. in ten years. It would, therefore, be wise to spend 7s. on the smallest joint to make it sound.

The cheapest joint is that which does not leak. It can be demonstrated that, where a pressure of pounds is used, a lead joint can never remain sound for long, whether the joint be an ordinary open joint in which pig lead is used, a special joint with lead wool, or a long sleeve or rigid joint. If there be lead in it at all, it will leak. A screwed joint is better than any open joint; but I am of the opinion that there is not a screwed joint on the market by which (say) fifteen or twenty lengths of pipe could be screwed together and tested at 100 lbs., that would stand dead-sound first time. Fiddling with them costs considerable money.

In the case of a welded joint, I am prepared to lay a mile of mains which shall stand dead-sound first test at 100 lbs. Again, a screwed joint is not a fixture. In connecting a further pipe or putting a tee in, a buried joint may be disturbed—slacked-back.

A screwed joint was never designed for soundness; it was designed for tensile strength.

Few people realize the part that high-pressure distribution will play in the progress of the future. It is only the few who realize what is actually happening, as it happens, in connection with anything in our industry. I feel I am able to realize something of the importance of high-pressure distribution, because I have had something to do with it. There are plenty of other matters more or less important that have a bearing on our general progress of which I may know nothing, and which I am, therefore, unable to appreciate. I do not expect anyone to follow my advice in the first instance, any more than I followed the the advice of my American friends. But I trust I do no harm in stating my opinions and beliefs; and, further, I hope that the manner of my stating them may not detract from their importance.

I should not have troubled you with this letter had you not asked for further particulars. When you do me the honour to publish my remarks, the least return I can make is to endeavour to clear up any misconception that you may be good enough to point out.

GEORGE HELPS.

Nuneaton, Nov. 12, 1913.

Street-Lamp Tests in Windsor.

SIR,—I see in "Electricity Supply Memoranda" of this week's "JOURNAL" [Nov. 4] a paragraph relating to the recent street-lamp tests made by Mr. Haydn Harrison, M.I.E.E. I am taking the liberty of sending for your perusal tests made by an expert photometrician not connected with either gas or electricity. The tests were made with a Simmance and Abady portable "Flicker" photometer standardized against a National Physical Laboratory standard lamp.

Mr. Harrison is wrong when he states that the metallic filament lamps were steadier than the gas arcs. Several members of the Lighting Committee remarked to me on the steadiness of the lamps. I have never seen a lamp burn steadier or with less noise.

I am also enclosing particulars of the tenders. We offered a four-light New British Graetzin high-power low-pressure lamp of about 1300-candle power for £12 per annum; two-light inverted lamps at £3 2s. 6d.; and single-light, upright or inverted, at £2 12s. 6d. per annum. Then, on condition that the Corporation gave us the whole of the street lighting, we offered to reduce the price of the smaller lamps by 2s. 6d. each. This would have meant a further saving to the ratepayers, and a much better light in the main streets.

GAS.

	Candle Power.		Cost per Annum.
31 arcs at (say) 1300 c.p. . .	40,300	31 at £12 . .	£372
300 single inverted, 70 c.p. .	21,000	300 at £2 10s. .	750
Total	61,300	Total . .	£1,122

ELECTRIC LIGHT.

31 metallic filaments at 600 c.p.	18,600	31 at £14 . .	£434
300 single inverted at 70 c.p. .	21,000	300 at £2 12s. 6d.	787 10
Total	39,600	Total . .	£1,221 10

The present tenders are as follows:

31 electric arcs, 2000 c.p. nominal (actual 1200) at £18 each . . .	£558
300 upright Bray burners at £3 5s. each	975
Total	£1,533

You will see that if all gas had been adopted, £411 per annum would have been saved to the ratepayers, which is over a penny rate (£300).

We must hope for better luck next time.

H. BUCKLEY, Engineer and Manager.
Windsor Royal Gaslight Company.

Windsor, Nov. 7, 1913.

[ENCLOSURE.]

Tests taken on street lamps with the Simmance and Abady patent portable photometer standardized against a National Physical Laboratory standard lamp, at Windsor, on Friday, Sept. 26.

Flame Arc Electric Lamp in Sheet Street opposite Victoria Street.

Result at 20° angle	1108·9 candle-power.
" " 50° "	1308·9 "
Mean	1208·9 "

Graetzin Four-Light High-Power Low-Pressure Gas-Lamp outside No. 10, Park Street.

Result at 20° angle	1301·6 candle-power.
" " 50° "	1340·2 "
Mean	1320·9 "

Flame Arc Electric Lamp opposite Roberts and Son's Music Shop in High Street.

Result at 20° angle	3283·6 candle-power.
" " 50° "	2224·0 "
Mean	2753·8 "

Three-Light Metallic Filament Electric Lamp opposite the Guildhall, High Street.

Result at 20° angle	1300·14 candle-power.
" " 50° "	588·74 "
Mean	944·44 "

ALEXANDER WRIGHT AND COMPANY, LIMITED,
per Wm. Edgar Rolph.

SIR,—I note that in your issue of Nov. 4 in the columns dedicated to "Electricity Supply Memoranda," you find space to mention Windsor. Under these circumstances, I should be obliged if you would find space for this letter in your next issue.

I venture to think that your remarks concerning Mr. Haydn Harrison and his report are not likely to impair the high reputation he holds, not only as an expert, but also for impartiality and fairness. But as you admit that you have not taken the trouble to obtain any "information which is worth having" I now suggest that you should do so, and ascertain why the results of the measurements made on the part of the Gas Company here have not been submitted to the Council.

As regards the last paragraph of your notes, might I remind you that illumination is not a matter of candle power only, but is affected by distance between the lamps, which is not always the same, and that the result of the Holborn tests was that the Gas Company lost half the contract which they had previously held.

I quite understand your natural antipathy to measurements of any description, especially photometry, but fortunately this is not shared by those who wish to make certain of obtaining that for which they pay.

A. E. FARROW.

Windsor Electrical Installation Company, Nov. 15, 1913.

[It is with the greatest pleasure that we publish Mr. Farrow's communication. For his own sake, we could have wished that his letter had shown rather more strength, and had not been of such a sapless nature. Regarding the second paragraph, there was no statement in the "Memoranda" to the effect that we had not taken the trouble to obtain any information which was worth having. What was said was

that the information published in an electrical contemporary respecting the matter under discussion was not worth having. The deficiency is repaired by Mr. Buckley's letter, with its enclosure, as published to-day. The letter by Mr. Farrow is worth having if only for the disclosure it makes of his ignorance of the Holborn tests and contract. We are pleased with his statement of elementary knowledge that illumination is not a matter of candle power only, but is affected by distance between the lamps. Really after this it would not be surprising if Mr. Farrow told us that photometry is founded upon the law of inverse squares. Precisely what Mr. Farrow says is what the Holborn tests and the Manchester tests proved; and he has not attempted to controvert them. The tests, in both cases, showed that, though the candle power of the gas-lamps was lower than that of the electric lamps, the illumination at the same distances away was by the gas-lamps in the one case greater than, and in the other case equal to, the electric lamps. Can Mr. Farrow explain this fact away, or must he concede the truth of a better diffusion of light on the part of the gas-lamps? It is not correct to say that the result of the Holborn tests was that the Gas Company lost half the contract they previously held; and we are surprised that any electrical engineer, with any sense about him, should make that claim. The offer of the gas-electric contract which is now running in Holborn was made by the Gaslight and Coke Company as the result of a *rapprochement* and agreement between the Electric Supply Company and the Gas Company. Had our correspondent been better informed as to the history of this matter, he would not have made such a stupid assertion. His "understanding" of our natural antipathy to measurements of any description, especially photometrical, is another egregious blunder the result of a want of intimacy with the subject of which he is talking.—ED. J.G.L.]

Control of Heats in Regenerator Furnaces.

SIR,—I was pleased to read that Mr. Darrah, in his letter in your last issue, endorses my views on the question of unexpected improvement of heats resulting from increases in secondary air supply.

In answer to his query, I certainly consider that this statement applies irrespective of whether the conditions with regard to regenerators, draught, and regularity of heats are, or are not, all that could be desired. His statement that the "increase observed in the temperature of the retorts has invariably been at the expense of regularity" rather suggests that the distribution of the secondary air is unequal, either from an insufficiency of nostril-holes or chokes in some of the ports.

With regard to the question of admission of secondary air, the following experience of Mr. Henry Hack, described in a paper he read at the Midland Association meeting and published in the "JOURNAL," Oct. 29, 1901, p. 1093, is especially interesting. Mr. Hack related his difficulties with a particular retort-house, which for months could not be worked successfully owing to the heats being far from satisfactory. Repeated analyses of the waste gases were made; and alterations in the primary and secondary air slides and dampers were made to meet what the analyses suggested was required. But all to no effect.

Mr. Hack stated that shortly afterwards he visited the Wolverhampton Gas-Works, where he noticed that the secondary-air supply to the settings was far in excess of that arranged in his own settings, on the basis of the analyses. On his return—ignoring all the analyses—he ordered the secondary-air supply to be practically doubled, with the result that in 48 hours satisfactory heats were obtained. After this, no more trouble was experienced.

This is a particularly interesting example of the vagaries of theory and practice. The regulation of air-slides is no easy matter; and this instance emphasizes the importance of not relying too much on analyses.

Mr. Darrah's advice on the question of short-circuiting is undoubtedly sound, as is also his opinion that waste-gas samples in the case of regenerators should not be taken at the damper outlet. I can endorse his statement that most surprising results may be obtained by making analyses of the waste gases from different parts of a setting. It does not do to assume that a bad test taken at the damper outlet will be repeated in a test taken from the flue under the bottom retort. It is always best, in the ordinary way, to sample the waste gas at the inlet to the regenerator.

I have to thank Mr. Darrah for his appreciative remarks.

Nov. 15, 1913. THE WRITER OF THE ARTICLE.

The Anglo-American Exhibition of 1914.

SIR,—In your issue of the 11th inst., you make a noteworthy suggestion, as follows:—

> "We seem, in connection with the gas industry, almost to require a sort of Intelligence Department, controlled by an Advisory Committee—a Department that could keep its eye on forthcoming events, ascertain where, if anywhere, the gas industry would be affected, and give counsel as to what movement, if any, the industry should make."

With reference to this, and also to the special action taken by Mr. Charles Carpenter in connection with a proposed gas demonstration at the exhibition of 1914, this will probably receive in due course the careful consideration of the Councils of the three representative Associations of the gas industry. But what I desire particularly to emphasize is that the suggestion you make with respect to an Intelligence Department is one which may be legitimately deemed as belonging to the sphere of the operations of the British Commercial Gas Association. The matter should demand, in my opinion, from the Council of the Association the appointment of an Emergency Committee to safeguard the interests of the gas industry on the lines indicated by you.

One hardly dares to suggest, in such a connection, the oft-repeated plea for a National Gas Institute, although I am convinced that the magnificent results achieved by the recent National Gas Congress and Exhibition at Shepherd's Bush can only be permanently realized and advanced by the provision of a permanent Gas Institute. The subject has, I believe, been receiving attention from the Councils of the three distinct Associations already referred to; but up to the present no definite proposal has been made public. There seems to be an impression that all the Associations should be included in one Institute, but having their separate departments. At the same time, there is no reason why an Intelligence Department, such as the one suggested, should not be formed conjointly. Indeed, some such amicable arrangement might eventually lead to the only sensible solution possible—namely, the amalgamation of the three independent Institutions into one powerful organization.

EDWARD A. HARMAN.

Huddersfield, Nov. 13, 1913.

A Safety Engineer for Gas-Works.

SIR,—In the article on "Works Topics" in the "JOURNAL" for Oct. 21 (p. 234), reference is made to an "innovation" by the appointment of a "Safety Engineer" by the Grand Trunk Company; and a recommendation is made of "a similar scheme in gas-works."

If "Modus Operandi" would read the paper prepared by Mr. J. B. Douglas for the annual meeting of the American Gas Institute, he would see that accident prevention is "the middle name" of the United Gas Improvement Company. Mr. J. B. Douglas is their "Safety Engineer," and he has an "eagle eye" for "hazards," as he calls them. He regularly visits all plants controlled by the Company, and can see a hazard where the local superintendent sees only normal conditions.

I believe you will find Mr. J. B. Douglas has the Grand Trunk Company "between forty ways from the middle" in starting and operating not only a new department in his Company, but in starting a "Safety League" among all gas companies.

Nashville, Tennessee, U.S.A., Nov. 3, 1913. A. S. B. LITTLE.

Corrosion of Steel Water-Mains.

SIR,—With reference to the Holwell Iron Company's letter in your last issue, *re* the above, we beg to say that the following points are ignored in their reply to our remarks: (1) That the Court of Inquiry itself attached no portion of the blame to the material used in the Goldfields steel main; (2) that the circumstances under which it was working were admittedly abnormal; and (3) that trouble was also experienced in the neighbourhood with cast-iron pipes.

As the cast-iron pipes connected to the Tay Bridge main are not on the bridge itself, there is no such direct comparison as your correspondent assumes. In any case, we would reiterate that both the mains in question are composed of entirely different steel from that we use, and have no bearing at all on our tubes.

We have hitherto refrained from putting forward cases of the rapid corrosion of cast iron which have come to our notice; but we feel that, in justice to our tubes, we must mention a case at Street, in Somersetshire, where some 9 inch tubes and Mannesmann steel spigot-and-faucet pipes were laid together—*i.e.*, in the same main—in 1903. The cast-iron pipes are now giving serious trouble through corrosion [as shown in a letter in the "Contract Journal" for Aug. 20 last]; but the Mannesmann tubes, which are laid under dykes, &c., and therefore in a a situation which should be the most conducive to corrosion, are not giving any trouble at all.

We do not propose to pursue this controversy any further, as we feel that no good purpose will be served by doing so.

BRITISH MANNESMANN TUBE COMPANY, LIMITED.
per J. T. Allingham.

Southampton Gaslight Company.

In moving the adoption at the half-yearly meeting of the report of the Directors [*ante*, p. 454], Captain A. J. Corse Scott, J.P., said he thought the shareholders would be satisfied with the accounts which had been placed in their hands. The Company were in the happy position of having earned sufficient profit to enable them to pay the maximum dividend of 5 per cent. per annum, and also add a small amount to the balance to be carried forward. Capital payments included an amount on account of the new retort-house and equipment. When this work was finished, the Company would have one of the most up-to-date retort-houses, fully equipped with modern machinery for the economical production of gas. The receipts for gas sold to private consumers showed a good increase, but from public lighting there was a decrease, owing to the policy of the Council in taking from the Company a very large number of lamps. In connection with this it could not be said that the ratepayers derived any benefit, as the price paid for the lighting was the same, and added to this was the cost of fitting-up the lamps. The past six months had been an anxious time for the Directors; but the Company had emerged successfully. The sales up to date were very satisfactory; and no doubt the result of the National Gas Exhibition would be to still further extend the use of gas in many directions. After the report had been adopted and the dividends declared, the Chairman and Directors and the officers of the Company were cordially thanked for their services—special reference being made to the good work done by Mr. F. Durkin (the Resident Engineer and Manager) and Mr. J. R. H. Jacobs (the Secretary)

Limerick Gas Inquiry.—At a meeting of the Limerick Corporation last Friday, a letter was read from Mr. M. Fitzgerald, the Secretary to the Gas Committee, intimating that they had considered the recommendations made by Mr. Drury, the Local Government Board Inspector, in connection with the recent inquiry into the management of the gas-works, and had unanimously adopted them. Mr. Drury's report was noticed in the "JOURNAL" for Sept. 23 last (p. 853).

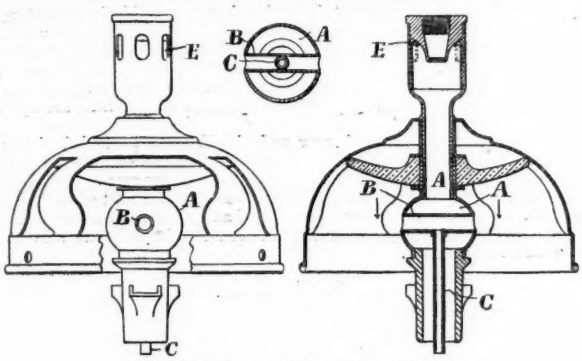
REGISTER OF PATENTS.

Inverted Incandescent Gas-Burners.

ALEXANDER, C. J., of Albany Street, N.W.

No. 21,152; Sept. 17, 1912. No. 3092; Feb. 6, 1913.

According to this combined invention, an inverted incandescent mantle burner is constructed to have the action of an aspirator for producing a flow of air, or air and combustion products, into a "medial hollow portion of the bunsen flame automatically and continuously, and in accordance with the pressure at which the gas is supplied to the burner—the provision for this introduction of air or air and products of combustion being distinguished by combining with the burner-tube a long axial air tube or pipe which is insulated throughout its length by the mixture of gas and air in its passage to the burner-nozzle."



Alexander's Inverted Incandescent Burner.

The structure of the burner of the type shown is well known, except that in the burner-tube A is inserted a transverse tube B, open to the atmosphere at both ends, and air-tightly fitting holes made in the wall of the burner-tube by which it is supported. Depending from this tube, and communicating with it, is a second tube C, which passes (preferably centrally) down the burner-tube to terminate at a point which will lie in a medial hollow portion of the bunsen flame produced by the burner.

Good results are said to have been obtained with the burner illustrated by having the vertical limb of the air-tube B C approximately 40 to 45 mm. in length measured from the axis of the transverse tube, and 3 mm. in internal diameter; the outlet end of the tube projecting beyond the mouth of the nozzle a distance of from 4 to 7 mm.—the transverse tube in this case having an internal diameter of 5 mm.

With burners constructed substantially as described, means for regulating the gas flow through the nipple of the burner or the main air supply to the burner-tube, or both, may be dispensed with if so desired, and (as illustrated) with fixed air ports E.

Regarding his invention, the patentee remarks: "Action of the air-tube wall in a regenerative sense assists to promote the efficiency of the burner; and the arrangement in the burner-tube of a vertical tube, with or without tubular branches leading to the exterior of the burner structure, is found to be useful in preventing the flame striking-back. The introduction of air by chimney action into the flame core of upright incandescent mantle burners has been suggested by arranging an air-supply pipe in the centre of the bunsen flame—this pipe, projecting into the flame beyond the burner-head, having access to the atmosphere through the base of the burner-head by way of obliquely directed tubes which connect the air-pipe with tubes arranged round the burner-tube parallel therewith.

Heating by Gaseous Combustion.

M'COURT, C. D., of Streatham Common, and BONECOURT SURFACE COMBUSTION, LIMITED, of Victoria Street, Westminster.

No. 23,536; Oct. 15, 1912. No. 24,294; Oct. 24, 1912.

This joined application for a patent has reference to heating by surface combustion, as described in patents Nos. 25,808 and 29,430 of 1909, No. 4364 of 1910, and No. 19,490 of 1912; the primary object being the utilization of the process for the heating, annealing, melting, or other heat treatment of metal, as, for example, armour plates, or for the melting or dead melting of charges or bodies of metal or other material in roofed furnaces which may be of the character of reverberatory or open-hearth furnaces.

Making Gas and Coke.

NELSEN, H., of Essen-Rüttenscheid, Germany.

No. 26,301; Nov. 15, 1912. Convention date, Nov. 17, 1911.

This invention relates to a modification of the vertical annular coke-oven described in patent No. 14,376 of 1912.

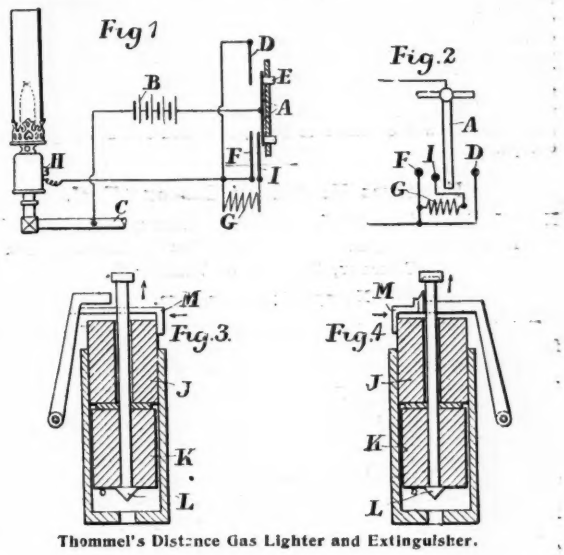
According to the present invention, the stopper closing the bottom of the annular coke chamber of the oven is packed relatively to the central part of the oven by means of a stuffing box. A water receptacle is arranged in the interior of the central-column of the annular oven, and, when the stopper is lowered for the purpose of emptying the oven, the water contained in the receptacle flows on to the coke. Moreover, nozzles are provided to enable the coke to be quenched from the inside. It is preferable, the patentee points out, to arrange this latter quenching device so that the cocks of the quenching pipes are opened automatically by the lowering of the stopper.

Lighting and Extinguishing Gas from a Distance.

THOMMEL, G., of Stuttgart, Germany.

No. 24,165; Oct. 22, 1912.

This electric apparatus for lighting and extinguishing gas from a distance is of the kind in which the ignition and extinction are effected by the differentiated operation of a contact device, the position of which is controlled by varying the quantity of electricity sent through a single-line wire, so as to vary the strength of the excitation of an electro-magnet.



Thommel's Distance Gas Lighter and Extinguisher.

Fig. 1 is a diagram of one form of construction; while fig. 2 shows another form of the contact device. Figs. 3 and 4 are examples of a device for shutting off the gas.

In fig. 1, the local branch circuit is switched on directly through the contact device A. The source of current B is earthed, for instance, by being connected with the gas-pipe C, and is also connected with A. This contact may be connected at one end with a contact D by pressing a buttom E, and at the other end by pressing on another button, with a contact F. From one end of a resistance G, arranged in conjunction with the contact device, wires lead to the contacts D F and the terminal H of the magnetically controlled device for shutting off the gas supply of the burner, while the other end of the resistance is connected with the contact I.

The device shown in figs. 3 and 4 is employed as a means for shutting off the gas for the main flame. In this device, the gas aperture to be controlled is below; while a fixed iron core J and a movable armature K are in the interior of a solenoid (not shown). The armature which carries at its lower end a valve body L for closing the aperture below is fast on a rod adapted to be displaced in the iron core J, which rod has at its upper end a collar. An armature M, of magnetizable material, is firmly connected with a locking lever pivotal on a horizontal axis. The position of the parts corresponds with a position of the contact device in which the contact A is directly connected with one end of the resistance G. Under these conditions, in view of the current existing in this case, the parts of the device for shutting off the gas are moved in the direction indicated by arrows until they are held by contacts or stops.

The method by which the device for shutting off the gas operates is as follows: It is assumed that the parts are in the position shown in fig. 3, and connection is made between the contact A and the contact F through the contact I by pressing the lower button. When the pressure on the button ceases, the contact I first moves away from the contact F while it is still touching the contact A. The circuit in this position of the contact device remains closed through the hitherto short-circuited resistance. This alteration of the current causes the armature K to descend in consequence of the reduced magnetization; so that the gas aperture is closed by the valve body L. The current weakened by the action of the resistance G is still strong enough to retain the armature on the iron core J, so that the locking lever does not impede the movement of the gas shutting-off mechanism. Only when the pressure on the lower button is further reduced, and the contact A moves away from the contact I—that is to say, the circuit is completely broken—is the armature released by the core J. But, owing to the valve being in the closing position, the locking lever is still prevented from moving by the collar above. Now, if by pressing the button E the contact A be brought into contact with D, the armature is lifted and the gas-valve is opened, while, simultaneously, the armature is again retained on the core by magnetic action. When the button E is released, the armatures are both simultaneously released in consequence of the entire cessation of the current. The lever (which turns about its pivot by its own weight in the direction opposite to that indicated by the arrow) then locks the armature K by engaging with the part beneath the ring, so that the device for shutting off the gas remains open.

In the closing device shown in fig. 4, the gas-valve is left in the closed position when the connection between the contacts A and D is broken. In this arrangement, when the contact I moves away from the contact F, and the armature K drops, the valve stem is held by the recess in the collar engaging the projection on the lever. Consequently, in the final position, when the connection between the contacts is broken, the gas-valve is closed by the armature K completing its detent.

Referring to his invention, the patentee says: "The ordinary arrange-

ments, in which the main-burner valve is only opened after the ignition of the pilot flame, which then heats an expansion body which acts on the main-burner valve member, have defects which affect the safety of working. By the main-burner valve being only opened after the pilot flame is lighted, unconsumed gas can escape from the main-burner valve if the circuit is broken at the precise moment at which the main burner is opened, as the main-burner valve then remains open, but the gas, in consequence of the extinction of the pilot flame, is not ignited. The same disadvantage may arise if for any reason the expansion body, or a part which operates the opening of the main gas-valve, is altered in such a way that, when the current is switched on for a short time, the valve is opened without ignition taking place. In the arrangements described, the disadvantages are avoided, because, firstly, the opening of the pilot and main burner valves takes place simultaneously, and, secondly, the main jet is ignited before the pilot flame is extinguished. Thus, so long as the main-burner valve remains open, the flame continues to burn. If, therefore, the circuit be broken, either the main-burner valve will close or remain open. In the latter case, however, the main-burner flame will continue to burn, and non-consumed gas cannot escape.

Furnaces Heated by Gaseous Fuel.

KING, J., jun., of Latchford, Cheshire, BURNETT, J. R., of Stockton Heath, Cheshire, and the RICHMOND GAS STOVE AND METER COMPANY, LIMITED, of Warrington.

No. 27,686; Dec. 2, 1912.

This invention (referring to annealing, hardening, muffle, or crucible furnaces) consists in a modification of patent No. 14,277 of 1911.

According to the present invention, the gaseous fuel and air meet at points in the furnace—thus doing away with an entirely separate combustion chamber, and utilizing the furnace chamber itself for the purpose. The secondary air flues or passages extend from the opposite side beneath the floor, and up the side of the furnace where the gaseous fuel is introduced, and may be controlled by valves, slides, dampers, or the like. The products of combustion are thus evenly distributed over the whole interior of the furnace; and, after being so distributed, leave by a flue or flues on the opposite side.

In a modified construction the products of combustion may, "in order to utilize the waste heat to the full extent," be caused, after issuing from the heating chamber, to pass into flues beneath the floor of the furnace and, if desired, around the heating chamber; or the flues may pass into a main flue underneath or at the side, or other convenient point—the secondary air passages being thereby heated by means of the heat from the flues.

Combustion of Liquid Fuel.

M'COURT, C. D., of Streatham Common, and BONECOURT SURFACE COMBUSTION, LIMITED, of Victoria Street, Westminster.

Nos. 28,477 and 28,478; Dec. 10, 1912.

Processes of combustion known as the "Bonecourt system of surface combustion," as described in patent No. 29,430 of 1909, and in other specifications of prior date to the present two, were only in connection with the combustion of gaseous mixtures.

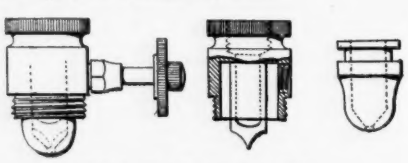
The present invention has for object to enable fuel in a liquid or semi-liquid condition (and not converted into a gaseous or vapourous condition) "to be employed, and use to be made of the accelerating influence that hot surfaces exercise on combustion, in the combustion of liquid fuel, and liquid fuel so combusted to be employed in industrial or other operations, as for example, in the heating of furnaces, or in the generation of steam and so forth."

Regulators for Gas-Burners.

PRICE, T. E., of Birmingham.

No. 909; Jan. 13, 1913.

This invention is particularly applicable to regulators for use with inverted incandescent burners, to regulate the supply of gas to the mixing-tube by a needle carried upon a member which is displaced longitudinally by a crank provided upon a transversely disposed rotating member adapted for operation by hand.



Price's Gas-Burner Regulator.

Instead of providing for the displacement of the movable needle in relation to the stationary part in which the jet is provided, the patentee provides (as shown) that the part in which the jet is arranged is displaced in relation to a stationary needle or member. The movement is, therefore, imparted to the outer cone or member having the jet, instead of to the internally disposed needle. By this arrangement it is possible to provide that the outer member having the jet may slide on the inner member carrying the needle. This arrangement is said to have the advantage that the relationship between the needle and jet is more correct throughout the different positions of adjustment—that is to say, it is difficult or impossible for oblique or eccentric relationship to occur between the jet and the needle, as in previous regulators, which has resulted in the gas issuing out of the centre, and which "detracts from the satisfactory incandescing of the mantle." Here the member having the jet slides longitudinally upon the exterior of the member having the needle—"this sliding fit providing a gas-tight joint and rendering it unnecessary to provide packing or other means for preventing escape of gas in connection with the transversely disposed operating member of the regulator."

Distilling Coal.

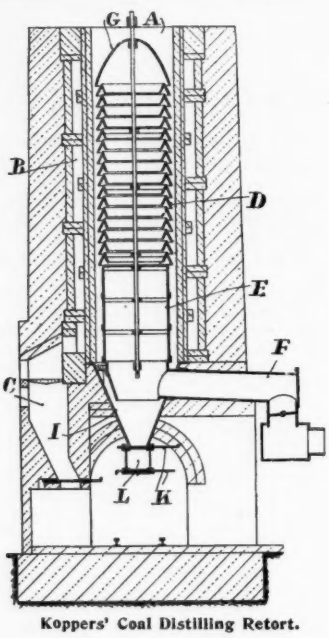
KOPPERS, H., of Essen-Ruhr, Germany.

No. 7601; March 31, 1913.

In the distillation of bituminous substances, the patentee states, "it is found that at low temperatures a large amount of tar is obtained, whereas at high temperatures, whether applied immediately or reached step by step, the highest proportion of ammonia is obtained. It is now usual to adopt a middle course, resulting in a medium output of tar and a medium output of ammonia; but the process of distilling in two stages at a lower and higher temperature has also been proposed—the production of ammonia at the higher temperature being assisted by introduction of steam."

The object of the present invention is "to provide improved apparatus for carrying out this last-mentioned process," by using "a retort or oven which is heated at the lower part to a higher temperature than at the upper part, and in which fuel is held in a thin layer against the wall by means of shields, plates, or the like placed in the interior, and having openings or gaps for the passage of gas into the space which they surround."

Neither of these features is new or in itself forms part of the invention, the novelty of which consists in confining the shields or plates (which have apertures or gaps in them) to the upper part of the retort, and holding the layer of fuel at the lower (hottest) part of the retort against the wall of the latter by means of an imperforate inner wall or plate—the steam being introduced between this imperforate wall and the wall of the retort.



Koppers' Coal Distilling Retort.

The vertical section of the apparatus employed shows a retort chamber A in the form of a shaft, surrounded by combustion chambers or gas flues B, to which gas is fed from a generator C. The heating system is so arranged that the lower part of the retort is heated more highly than the upper part. Within the retort is a vertical series of annular members D, overlapping each other, but spaced apart, so that they can hold up a layer of coal against the wall, but give free passage to gas into the internal space they surround. Below this series of members there is an imperforate cylinder E, also spaced from the inner surface of the wall of the lower part of the retort. A cap or cupola G covers the series of rings, but the cylinder E is open at the bottom to the outlet F. The annular space around the rings D and cylinder E communicates at the bottom with a hopper I, whence the residual part of the charge can pass into a discharge neck L between two valves K.

The fuel is fed in from above, and forms a thin layer in the retort. The gases pass between the rings D into the cooler interior of the retort, and are sucked off. In the first stage of the distillation the fuel, passing downwards through the upper part of the retort, loses its tarry constituents; and in the second stage the whole of the ammonia is removed. The output of ammonia is increased by introducing steam into the lower part of the distillation chamber; and this steam assists in preventing the decomposition of the ammonia. The fact that the cylinder E has no apertures in its wall ensures, it is said, that the steam is compelled to traverse the entire length of the space between the cylinder and the wall of the retort, whereas, if the cylinder had apertures such as the gaps between the members D, a large amount of steam would pass into the central chamber without traversing any considerable thickness of fuel.

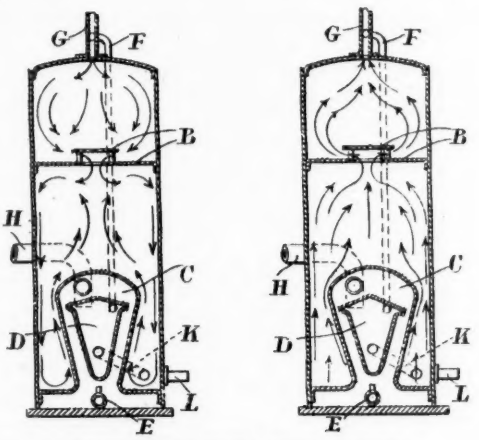
Hot-Water Apparatus.

POTTERTON, T., of Balham.

No. 7677; April 1, 1913.

This hot-water apparatus is of the self-contained or portable type, comprising in the one apparatus two intercommunicating separate

vessels—the one adapted to be subjected to the direct action of the heating means, and the other adapted for connection to the cold water supply.



Potterton's Gas-Heated Water Circulator.

The two diagrammatic sectional elevations given show, by the arrows, the course of circulation when no water is being drawn off from the hot-water cistern, and the course of circulation when water is being drawn off.

The cistern is formed with a large cavity C at its lower part, into which the boiler D is fixed so as to be heated by the burners E below. A pipe F is led from the upper part of the boiler to the top of the hot-water cistern, so that the heated water flows into the top of it through the withdrawal pipe G. The products of combustion are removed from the upper part of the cavity C by the outlet flue-pipe H, which is led to the side of the hot-water apparatus without passing upwardly through the hot-water cistern as is usually the case.

By this arrangement of the boiler within the cavity of the hot-water cistern the flames from the burners E not only serve to heat the boiler, but, as they spread around it, they also serve to heat the sides of the cavity of the hot-water cistern—thus causing a circulation of the heated water. The circulation, as shown in the first diagram, is caused by providing baffle-plates in the hot-water cistern. The cold water from the supply cistern enters the hot-water cistern by the pipe L at the bottom, and another pipe K connects the bottom of the hot-water cistern with the lower part of the boiler; so that the water circulates from the bottom of the hot-water cistern into the bottom of the boiler, and from the top of the boiler to the top of the hot-water cistern. Thus the hottest water is always withdrawn.

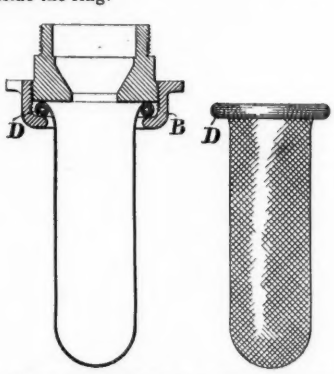
High-Pressure Inverted Incandescent Gas-Mantles.

SOUTH METROPOLITAN GAS COMPANY and CHANDLER, D.

No. 15,558; July 5, 1913.

The object of this invention is "to obviate the necessity of attaching high-pressure mantles to their rings at the factory, and thus enable such mantles to be packed and sent out in a burnt-off collodionized state with safety."

Accordingly the mantle is formed with a bead, preferably by rolling up the fabric at its open end; and the ring is in the form of a union with a thread, bayonet attachment, or other device for securing it to the burner. The mantle is dropped through the ring, and the bead of the mantle, resting on the interior of the union, is retained between it and the lower end of the burner, against which the bead is closely pressed so as to ensure that the products of combustion pass through the mantle and outside the ring.



Chandler's (South Metropolitan Gas Company) High-Pressure Inverted Mantle.

A vertical section through the burner end, the ring, and the mantle, and an elevation of the mantle are shown. From these it will be observed that the ring B has an opening large enough to allow the body of the mantle to pass, but it is small enough to catch and support the bead D.

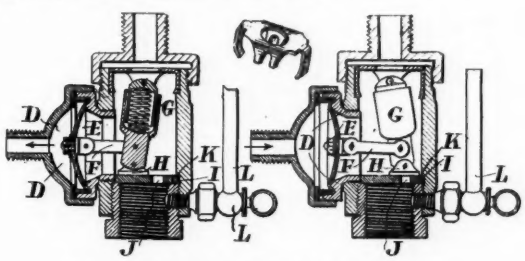
It will be found in practice, the patentees state, that a mantle, however large, will travel safely when in the burnt-off and collodionized state, provided no heavy ring is attached to it. In the stocking state, the mantle with the ring attached will likewise travel safely; but "in that case the disadvantages of having to burn-out the cotton when the mantle is in the lamp have to be put up with."

Fluid Operating Control Devices for Gas Systems.

SPERRYN, G. N., and BARRETT, S. R., of Birmingham.

No. 18,555; Aug. 15, 1913.

This invention more particularly refers to devices used on gas lighting systems for enabling the light to be controlled from a distance. An earlier patent was granted to the inventors (No. 23,039 of 1910) for an improvement in devices of this character "consisting in actuating a sliding valve through a rod and pendulous rod directly engaging the valve; resilient pressure being applied to the valve through the pendulous rod." Their present improvement has for its main object to provide a better construction of the pendulous rod and the arrangement for applying resilient pressure to the sliding valve.



Sperryn and Barrett's Lamp Lighting Controller.

The valve shown is fitted for an upright pattern burner, but by changing certain of the fittings it is rendered suitable for an inverted burner, as set forth in the earlier patent.

The body has an opening in one wall in which a diaphragm chamber D of a pneumatic or other pressure system is secured. From the diaphragm E is a connecting rod F to the pendulous rod G, which is connected at its lower end with the sliding valve H, and is suitably suspended from its upper end. The valve travels over the seat I, and either obturates a hole J therein, or permits a passage through it. The seat in the example shown is formed separate from the body, and is held in place against a shoulder K by the gas connection; and the bye-pass connection L is screwed into the body in such a manner as to lock this connection member.

The pendulous rod G is formed in two parts telescoping into each other. Between the parts a spring is arranged, tending to separate them, and thus apply resilient pressure upon the valve. The rod is hinged by a trunnion pin or projection engaging slots in turned-down lugs of a cap which has two more or less spring-side pieces which engage slots in the body.

APPLICATIONS FOR LETTERS PATENT.

25,003.—BERRY, J., FOWLER, R., and METERS, LTD., "Gas-meters." Nov. 3.
25,067.—ACKROYD, J. H., "Gas-burners." Nov. 3.
25,151.—TILLEY, F. C., "Gas-lamps." Nov. 4.
25,175.—GIDDEN, W. T., "Purification of gas." Nov. 4.
25,271.—TAYLOR, H. A., and BRITISH AND COLONIAL LIGHTING COMPANY, LTD., "Carburetting air." Nov. 5.
25,317.—HUMPHREY, A. H., "Gas-lamps." Nov. 6.
25,321.—HAMILL, W. W., "Liquid meters." Nov. 6.
25,380.—ANDERSON, D., "Gas-stoves." Nov. 6.
25,381.—HIBBERD, C. E., and GOAD, F. L., "Gas-meters." Nov. 6.
25,383.—BERRY, J., MAYLOR, J. A., GLOVER, W. T., and METERS, LTD., "Meters." Nov. 6.
25,424.—GRUBB, D. B., and BUTLER, H. B., "Automatic gas-controllers." Nov. 7.
25,566.—CRIBBES, G., and PETERSON, J. W., "Gas-generators." Nov. 8.
25,585.—DWYER, J., "Ammonia gas condensers." Nov. 8.
25,590.—EVERS, G. V., and J. PEARSON, LTD., "Gas-retorts." Nov. 8.

Going Back to Oil at Princes Risborough.—The Buckinghamshire town of Princes Risborough was one of the first places in the district to adopt incandescent gas for public lighting, and it has had the reputation of being one of the best-lighted towns in the neighbourhood. At the present time, however, the place is without light. The Parish Council, who appear to have some prejudice against the Gas Company, have delayed until now making arrangements for carrying out the public lighting for which a parish district meeting voted the money in July; and the residents are to "advance" in this matter by having the town lighted by some system of oil-lamps!

Tar Prices at the Coleraine Gas-Works.—At a recent meeting of the Coleraine Gas Committee, the prices charged for tar at the gas-works were considered, and it was resolved to increase the price of 40 gallons from 6s. 6d. to 8s., and of 25 gallons from 5s. to 5s. 6d.; the Town Surveyor's department to be charged 6s. 6d. per barrel of tar used in the manufacture of tar macadam, instead of 5s. as hitherto. The Clerk of the Urban District Council, on the matter being mentioned, remarked that the charge for tar sold locally was considerably less than the Committee were getting for it wholesale, and that it was not deemed wise for them to keep to the low prices. The Council approved of the Committee's action.

LEGAL INTELLIGENCE.

WATER CHARGES TO LICENSED CATERERS.

HOUSE OF LORDS—Friday, Nov. 14.

(*Before Lords* HALSBURY, ATKINSON, KINNEAR, *and* DUNEDIN.)

Metropolitan Water Board v. Avery.

This was an appeal from an order of the Court of Appeal affirming a decision of Mr. Justice Channell and Mr. Justice Bray, which reversed a judgment of the County Court in an action in which the appellants were the plaintiffs and respondent was the defendant.

Mrs. Avery is the occupier and licensee of the Crutched Friars Hotel, John Street, Minories. The appellants in May, 1912, brought an action against the respondent for 5s. in respect of water supplied to her premises. It was contended by them that the water used for the catering business which the respondent carried on was a supply for trade purposes within the meaning of the Metropolitan Water Board (Charges) Act, 1907. The County Court Judge upheld the contention, and gave judgment in favour of the appellants, on the ground that the catering, although carried on in connection with the public-house, was a trade or business which necessitated the use of a considerable quantity of water in excess of that which would have to be employed for the ordinary trade of a publican. The Divisional Court held that the water in question was used for domestic purposes and not for trade; and this view was supported by the Court of Appeal. The proceedings in the Divisional Court were reported in the "JOURNAL" for March 25 last (p. 832); and those in the Court of Appeal in the number for July 29 (p. 319).

Mr. CLAVELL SALTER, K.C., M.P., in opening the case for the appellants, read the judgment of his Honour Judge Woodfall, given in the County Court, which set out the facts. He said it was unfortunate, from his point of view, that the question had been raised in respect of so very small an amount; but it was one of great importance, as it covered all the restaurants and laundries, and he was not sure that breweries could not be brought in. It also covered a large number of trades which consisted in the performance of what were really domestic operations. Section 25 of the Metropolitan Water Board (Charges) Act, 1907, defined "domestic purposes." It took two classes of cases —those in which water was used for purely domestic purposes, collo quially understood, and those in which it was employed, colloquially speaking, for both domestic and trade purposes. For the former, the Legislature intended only the domestic rate to be charged, and for the latter the trade rate. His submission was that the proper way to approach the question which had to be answered in this case was to begin by asking: Did the particular supply of water to a catering business come under the category of "domestic purposes"? He contended that water was used for trade purposes if it was employed in the earning of the reward of that trade, as distinguished from the use of water more or less incidentally.

Lord HALSBURY said he quite agreed with Lord Loreburn, in a case formerly decided in their Lordships' House, that the language of the Act was loose, slovenly, and inaccurate.

Mr. CLAVELL SALTER then read the judgments given in the Divisional Court and the Court of Appeal.

Sir ROBERT FINLAY, K.C., M.P., followed on the same side.

At the conclusion of the arguments for the appellants,

Lord HALSBURY said that if it were necessary to hear the respondent, intimation would be made to this effect.

This remark is equivalent to a decision to dismiss the appeal.

Inquest on a Fulham Gas-Works Employee.

At the Coroner's Court, Fulham, last Tuesday, an inquiry was held by Mr. Luxmore Drew relative to the death of John James Joseph Freeman (28), lately employed at the Fulham works of the Gaslight and Coke Company. Mr. C. Beasley Robinson (of Messrs. Monier-Williams, Robinson, and Milroy) appeared for the Company; Mr. E. V. Clarke, one of the Inspectors of Factories, represented the Home Office. The father of the deceased said his son came home from the gas-works on the 5th inst. at half-past eight, and said he had been lifting some planks when he suddenly felt a click, and a pain in his stomach. A doctor was sent for, who prescribed for him; but he died the following Friday. In answer to Mr. Robinson, witness said his son had been in the Army, but was not invalided out. John Tarkey, employed at the gas-works, stated that the deceased was engaged in lifting planks 24 feet long, 11 inches wide, and 3 inches thick; and there were two or three men to each plank. No complaint was made to him, nor did he hear of any accident. Charles Wooley said there were seventeen men employed in the gang lifting the planks, and the work was not hard. Dr. Williams deposed that he attended the deceased. He was told he had been vomiting, and had a good deal of abdominal pain. He examined him, but could not find anything wrong; and he thought it was an ordinary case of constipation and prescribed accordingly. He was subsequently told about the lifting of the planks, and he then advised removal to a hospital; but death took place before this could be done. Dr. Spilsbury, Pathologist at St. Mary's Hospital, said he made a *post-mortem* examination of the deceased, and found most of the organs healthy; but there was a chronic ulcer which had become perforated, setting up acute peritonitis, and this was the cause of death. In his opinion, the lifting of the planks had nothing to do with it. The Coroner having addressed the Jury, they brought in a verdict in accordance with the medical evidence; stating that they were agreed as to it being an accidental death, and not brought about in any way by the lifting of the planks.

We have received from Meldrums Limited, of Timperley, near Manchester, copies of recent catalogues of their improved forced-draught furnace, refuse destructors, and mechanical stokers.

MISCELLANEOUS NEWS.

ASHBORNE GAS-WORKS PURCHASE ARBITRATION.

The Case for the Council.

In last week's issue a report appeared of the first portion of the proceedings—the case for the claimants—in the arbitration which took place recently, at the Surveyors' Institution, Great George Street, S.W., to determine the price to be paid by the Urban District Council of Ashborne for the undertaking of the Ashborne and District Gas Company. This is supplemented now by the main points of the Council's case.

Mr. ERNEST MOON, K.C., acted as Umpire; and there were with him as Arbitrators Sir CORBET WOODALL, D.Sc., for the Company, and Mr. HARRY E. JONES for the Council.

The Counsel appearing were Mr. C. C. HUTCHINSON, K.C., and Mr. W. J. JEEVES (instructed by Messrs. Hargreaves and Crowthers) for the Company; and Mr. HONORATUS LLOYD, K.C., and Mr. ST. J. D. RAIKES (instructed by Messrs. Dyson and Co.) for the Council.

Mr. HONORATUS LLOYD said he would at once proceed to call evidence for the Council.

Mr. *J. Ferguson Bell*, of Derby, was the first witness, and was examined by Mr. HONORATUS LLOYD. He said he knew Ashborne, and on visiting the works the Manager had given him all the information he required. There were no complaints; and there was no doubt the working results were good. It was a small market town, and had been almost stationary, except for the last year or so, since Nestlé's put their works there. The proportion of the houses already supplied was a very large one; and he did not see much promise of it being increased. He had made a structural valuation, amounting to £16,440. In his calculations, he gave 8500 cubic feet per mouthpiece, and multiplied this by a load-factor of 218, which gave, in round figures, 28 million feet. The load-factor was the proportion of maximum daily output to annual make. Various alterations were needed in the present plant to bring it up to 28 millions. Practically there was no excess in the plant, with the possible slight exception of the exhausters. New coal-stores should be erected to hold 500 tons, so as to give the Company six weeks' stock of coal at the maximum requirements. The Company used screened coal, which did not suffer so much as slack from exposure. The storage available for coke, also, was quite inadequate. One of the small gasholders ought to be removed, and the space utilized for the storage of coke. No doubt this winter all the retorts would be under fire; and it was absolutely necessary to have one unit for reserve. The retort-house was in a very poor condition from a building point of view; and a new boiler and boiler-house were necessary. The condenser was entirely worn out, and ought to be replaced; and a covered-in oxide shed would be desirable. Alterations to the purifiers were needed. The Company were short of gasholder room, which should be at least equal to 24 hours' maximum consumption. The best way to provide this additional storage would be by putting up a 100,000 cubic feet holder. The proportion of the day load here did not affect this view. Several other additions were recommended. All the items he suggested added together made a sum of £2185, which he thought was chargeable against the Company for deficient works. An insufficient sum was shown in the accounts as expended during past year on maintenance and repairs. He thought the sum that ought to have been spent and allowed in the accounts was 9d. per 1000 cubic feet; and he had added to the sum charged in the accounts a sufficient amount to bring it up to his figure. This was £497. He deducted the profit on fittings and 5 per cent. on the £2185 for deficient works; and these three items made £648, which, deducted from the profit shown of £2038, left a maintainable profit of £1390. For this he took a multiplier of 20 years' purchase, which was a proper figure, because the capital might be re-invested at the present time in well-known statutory companies to give a yield of 5 to 5½ per cent. To this he added profit on fittings at three years' purchase, giving a total of £27,926. These profits were earned in conjunction with the utilization of working capital; but the undertaking, according to the Act, had to be handed over without any working capital. Therefore there should be a reduction in respect of this. He put £1000 for this, giving a figure of £26,926, which, in his view, would be a good price for the undertaking. The coal strike last year operated beneficially to the Derby Gas Company; for they obtained better prices for residuals. In fact, during that year they did better than ever before, because they paid the total cost of their coal by means of residual products. It did not seem to him that there was any special consideration due to the Company because of the account year being 1912. It was decidedly in their favour, because coal had since gone up from 1s. to 1s. 6d. per ton, while residuals had gone down as compared with last year.

Third Day.

Mr. *Bell*, cross-examined by Mr. HUTCHINSON, said that he did not make any suggestion of complaints about the supply, and would not be prepared to say the works had not been carefully managed. There would probably be a small increase in the consumption of gas. He said a buyer would have to spend £6700 in putting in new and up-to-date plant, which would result in slightly more profitable working. It was really, however, to give the undertaking a reasonable reserve against breakdown. The coal-stores ought to be taken down and new ones put up to hold about 500 tons. It was also absolutely necessary to provide more room for the storage of coke; and a new retort-house and condensers were required. The improvements suggested in the purifiers would not make them equal to 360,000 cubic feet per day. He did not lay down an inflexible rule that, whatever the character of the consumption, the storage accommodation should be equal to 24 hours' supply; but it was a very good rule. There was nothing to show that results had been affected by insufficient repairs and renewals; but the 5·58d. per 1000 cubic feet was deficient to the extent

of over 3d. He expended at Derby last year 9d., and charged to revenue just over 10d. He added that 9d. was an agreed figure; and he did not think any company could do it for many years at less than this. His experience was that of the 9d. about 1¾d. was in respect of depreciation. There was some charge for the reconstruction of the Belper works included in the 1912 figure at Derby. They had De Brouwer machines at Derby for stoking. Questioned as to a quotation in the "JOURNAL" for Derby gas stock, which showed a yield to the investor of about 4 per cent., witness said there must be something wrong there.

Mr. HUTCHINSON: Yes, there is something wrong there for you, but not for me.

Re-examined: With reference to the point about working capital, if he had two identical companies offered to him, and one agreed to hand over (say) £1000 of working capital, and the other did not, the one that proposed the handing over of the £1000 would be of more value to him than the other.

Mr. *Edward Allen*, of Liverpool, replying to Mr. RAIKES, said he had acted in this matter in conjunction with Mr. Bell, and the various tables put forward (with the exception of the structural valuation) had been jointly prepared. With regard to his structural valuation of £16,800, he had taken the capacity of the present plant at about 28 million cubic feet per annum. He arrived at this by reckoning fifteen of the retorts as being able to produce this quantity. Taking the make per mouthpiece at a generous figure of 8500 cubic feet, gave 127,500 feet per day, against the 128,000 feet actually sent out on the maximum day last year; and this multiplied by the factor of 218 gave roughly 28 million cubic feet. The six retorts in the other setting, he considered, should be kept under fire in the winter as a stand-by, but not used unless called upon by exigencies of weather or breakdown. This was the rule he practised in his own works. To do what he had calculated, the fifteen retorts would have to be worked to the utmost. His own figure would be 8000 feet per mouthpiece, and not 8500, working six-hour charges. Of course, what might be done under special circumstances one hardly knew. In a difficulty, a man might charge every three or four hours, and somewhat waste his coals and lower his heats, in order to get more gas.

Sir CORBET WOODALL: But there is no suggestion, is there, that he had to do this in order to get 8500 feet?

Witness: I understand not.

Examination continued: The retort-house in question he considered very unsatisfactory in many respects; and his suggestion would be to rebuild it, and place the boilers in another building. A larger yard should be provided for coke; and the only way of doing this would be to scrap one of the two smaller holders and fill the tank in. The condensers were worn out; and it was very fortunate that no trouble had occurred in them, or the works would have been stopped. The purifying plant was good, with the exception of the method of working; and he would recommend the carrying out of the alterations already referred to. With reference to storage, he suggested that the two small holders should be scrapped. They did not give sufficient pressure to meet the requirements of the lighting hours; and he doubted whether they were quite suitable for the daylight hours. He would put up a new 100,000 feet holder, which, together with the existing 70,000 feet one, would give a margin of excess plant. In his opinion, the gasholder accommodation should be equal to the maximum day's output, especially in a works of this character. He would make an exception of a works where there was a water-gas plant, which could be quickly put into operation. The station-governor was too small; and, in addition to this, to rely upon one governor alone was not safe. The mains on the works varied in size; some being 7-inch, and others 8-inch. They should be at least 10 inches all through the works. As to the district mains, it seemed to him that the 8-inch main going to the town was too small, and should be replaced by a 10-inch main. There were certain 2-inch mains; and these were unsatisfactory.

Mr. HARRY JONES: Would not all this be betterment? The effect of these alterations is improvement.

Witness: To some extent; but the matters I have referred to indicate that the undertaking is not up to date—is, in fact, deficient in certain respects. No doubt, the undertaking would work rather better.

Examination continued: He agreed generally with the last witness on the subject of repairs and maintenance.

Sir CORBET WOODALL: That anything less than 9d. would be a deficient allowance for maintenance, repairs, and renewals?

Witness: I would rather say that 9d. is a fair figure—to cover depreciation as well as actual repairs and renewals.

Cross-examined by Mr. HUTCHINSON, witness said there was only £360 difference between him and Mr. Bell. Taking the agreed tables and the working of the undertaking, there was nothing which could be said to indicate deficiency. The management had been very fortunate in being able to get such good results up to the present. There was no evidence of past overwork when he was last at Ashborne. The supply had been satisfactory, and he was not there to say it had not. If the purifiers were altered in the way suggested by the other side, they might run for six months. As to the figure of 9d., he could not say that this amount was spent in every well-managed gas-works. In respect of meters and stoves, depreciation would be included in the 9d. He thought 3d. would be too much to take as being the proportion for this depreciation. It was suggested by Counsel that a working-out of the figures contained in the Board of Trade returns and the Liverpool Gas Company's accounts gave a figure of 5·3d. per 1000 cubic feet for repairs, maintenance, and renewals of works and plant, mains and service-pipes, meters, and stoves; and witness replied that the year taken happened to be quite a low one. The average for ten years for works, mains and services, and meters was 6·06d. It was only quite recently that the Company had taken up the question of gas fires and cookers on hire. Last year it appeared as 1·08d.; but he was quite sure it was an insufficient figure, and that this year it would be very much bigger. Taking the maximum figure under each heading for the past ten years, and adding 2d. for stoves and fittings, a total of practically 9d. was arrived at. When a main was taken out and replaced by a larger one, the whole amount would be charged against revenue.

Mr. HARRY JONES: Would it be your view that a large works would carry out repairs much cheaper than a small works?

Witness: That is my opinion.

Sir CORBET WOODALL: Do you maintain that the cost of repairs and maintenance of works is greater in the case of a small undertaking having no machinery than in a large works having a considerable amount of machinery? In a large works, you not only have machines for the retort-house, but for carrying coal and coke, and so forth. Would the repairs in a works so equipped be less than in a works which had only to provide the barrow and shovel?

Witness: I should not like to give an unqualified answer; but, so far as I have been able to test it, the cost of maintenance of retort-houses has been reduced by the use of machinery.

The UMPIRE: In reference to the repair and maintenance of stoves and meters, does it not seem to you to be a very fallacious process to take so much per 1000 cubic feet of gas supplied, and to make that a figure to apply to all gas companies.

Witness: It might unfairly affect one gas company or another; but you must adopt some statistical way of dealing with things, and I do not know a better.

Mr. *Frank H. Jones*, examined by Mr. HONORATUS LLOYD, said he agreed with the structural valuations put in by Mr. Bell and Mr. Allen. The consumption of gas per consumer was about 30,000 cubic feet, which for such a town was a pretty high average. The management of the works had been good; and the Manager last winter got as much as he could from them, with economical and safe working. For such working, the capacity of the works was not more than 28 million cubic feet per annum. To supply 32 millions, they would not have a safe margin—that was, they would not have a bed of retorts in reserve. A day's storage was a proper allowance; and the smaller the works, the more necessary was it to have this. He was in accord with Mr. Bell and Mr. Allen with regard to the deficiencies in the plant. As to repairs and renewals, he was convinced that 9d. was necessary in a works of this size. In 1912, the amount the Company were spending was about 2½ per cent. on their capital of £20,000 for all repairs and renewals, and putting money on one side for necessary renewals when required. The 9d. would give them 5⅛ per cent. on the same capital. This could not be too much to spend on an undertaking like a gas-works, a large portion of which was liable to very heavy wear and tear. He regarded 9d. as a minimum. As to the number of years' purchase, he agreed with the 20 years, which was fair, looking at the maintainability of the profits of the Company and the condition of the Money Market. Shareholders could get 5 per cent. and over in good statutory companies. Three years' purchase of the fittings profit seemed quite reasonable. A company which handed over to the purchaser working capital must be worth more than one which did not.

Cross-examined by Mr. HUTCHINSON, he did not agree that the storage accommodation at Ashborne was 90 per cent. of the heaviest day's make, or that the outlay suggested for reconstructional work would add to the profits. This latter was necessary for economical and safe working. Possibly in the Sidmouth case he had quoted 6d. for repairs and renewals, and 3d. or some such figure under the head of depreciation—which to his mind was just the same as renewals. He could not to-day honestly take a non-statutory gas company, unless there were some very extraordinary points about it, at more than 20 years' purchase, knowing one could get any amount of stock in good statutory gas companies to pay 5 or 5½ per cent.

Sir CORBET WOODALL: Would you mind mentioning one or two cases in which you know that a sum such as 9d. is spent on repairs and renewals in small works?

Witness: At Burnham-on-the-Crouch last year we spent 14d.; and it is more this year. Sheringham, 7·43d.; but that is not quite a true figure, because it is a gas and water undertaking, and the mainlayers do the whole thing together. The Brentwood Gas Company spend 10·10d., and Pinner 8·67d. Others are Bishop's Stortford (which consists of several different works), 9·74d.; Epsom, 12·67d.; Watford, 11·18d.; and Uxbridge, 11·36d. As a consulting engineer or director, I would never have anything to do with any company that did not, over a period of years, give an average like this. I should say they were taking profits out of it to which they were not entitled.

The UMPIRE: It is a very complicated question, upon which I do not think you can lay down any principle.

Witness: I think in many cases 9d. is not enough.

I have been testing the Liverpool figures by your figures; and taking 4304 million feet, and £700 per million, I tried to see what their actual expenditure of £95,000 amounted to. It does not come to 5 per cent., or anything like it.—I do not think the £700 would apply to Liverpool. If your capital is £1000, and you spend 9d., you are spending 3·75 per cent. of your capital. If it is £700, and you are still spending 9d., it is 5·3 per cent. If the capital is £500 a million, you are spending, at the 9d. rate, 7·5 per cent.

Mr. *William Cash* said he had been through the books of the Company, and had agreed the figures for the tables with Mr. Schultz. No provision had been made for depreciation of meters and stoves. He did not think he knew of a single company among those he was connected with who did not provide for depreciation of stoves at least, and in a great many cases of meters as well.

Cross-examined: He would say depreciation was an almost universal practice.

The UMPIRE: I do not think the practice ought to guide me. I have to determine what is right in principle.

Mr. HUTCHINSON: As a matter of practice with regard to sums that are written-off revenue in each year for depreciation, are they not expended in buying new meters to extend the business? In fact, there is no fund?

Witness: It may or may not be. The point is that it is not distributed as profit—and should not be.

Mr. *Henry Woodall* was re-called to give information as to companies having less storage than 24 hours' output. He quoted Christchurch as having 69 per cent., and Tottenham 63 per cent. Both Companies, he said, were going to build holders. Tottenham made water gas. There were some little gas companies in Derbyshire which came very much below Ashborne.

SPEECH FOR THE COUNCIL.

Mr. HONORATUS LLOYD, in the course of his address for the Council, remarked that the other side suggested that the undertaking was worth

some £60,000, denuded of the various things of which it was denuded by their definition of the Act. In arriving at the maintainable profit, the question was to what extent the adjustments on the year 1912 were fair and allowable. He suggested that the line laid down by Parliament was that, inasmuch as the Act was obligatory, the tribunal had to take the position and interest of the Company as it was in 1912, at the time of the passing of the Act. If they succeeded afterwards in getting further business, it was to be done with the Council's capital, which was to be repaid to the Company.

The UMPIRE: The profits which are so earned, are earned, of course, not only by the use of the mains which are to be paid for by the Council, but by the use of the works of the Company.

Mr. HONORATUS LLOYD: Yes; assuming that they had works which were capable of dealing with more than they then had to deal with, and they laid mains, then the excess works beyond those they were then using would be utilized as well as the new mains for making the profit.

The UMPIRE: Why should they not be entitled to the capitalization of the profits which were made far more by the use of capital which they had expended than by the use of the capital you had expended.

Mr. HONORATUS LLOYD: Being a non-statutory Company, they have no right to lay mains in streets; and therefore Parliament says you shall value them as they stood in 1912. If they have excess works, the Arbitrator will take them into consideration; but the interest that you have shall be stereotyped, and you shall not, now that this question has arisen, begin extending your mains all over the place, and then say, "We are going to have the capitalized profit."

Continuing, Counsel proceeded to deal with the valuations, and then referred to the differences of opinion as to the necessary charges for maintenance and renewals.

Sir CORBET WOODALL: One set of witnesses stand out for a considerable addition to the amount actually needed for repairs and renewals, and call it depreciation, and the others confine themselves to what is really needed for the regular year to year upkeep of the undertaking.

Mr. HONORATUS LLOYD: That shortens my labours very much. The difference that exists between us is the difference of principle as to whether or no there ought to be a sum put aside in order to deal with the depreciation of meters, stoves, and fittings.

Sir CORBET WOODALL: Do not take me as meaning that only. Mr. Allen gave you an instance of where things are renewed, and in the renewals is included an increase in the capacity. That increase is charged to repairs and renewals, so that there is depreciation all along the line.

Mr. HONORATUS LLOYD: Now I think I can narrow it still further, because, as a matter of fact, if in 9d. our witnesses mean that you ought to pay not only for replacing that which is worn out, but also for additions, I should not claim it. I do not think that is right.

Sir CORBET WOODALL: It has been claimed to-day.

Mr. HONORATUS LLOYD: If that is the question of principle between us, then the principle is gone. I do not think that any man in this room will argue with any success that not only replacing but increasing the size of a main was renewal. All I am saying is a figure should be charged that is sufficient to renew and replace the article with a similar article—no better, and no larger; and it is on this basis that we have put forward our 9d.

The UMPIRE: Everyone is at one that it has to be done at some time or another. The only question is when it shall be done, whether in a lump or over some years.

Mr. HONORATUS LLOYD (continuing) said they must agree that the Company were, through the coal strike, restrained to some extent in the sale of gas during 1912; but they should also take into consideration the effect of the price of residuals on the net cost of coal. He then dealt with the capacity of the works, and also the number of years' purchase. He pointed out that the Company would hand over an undertaking stripped bare of everything except the works and the goodwill. The Council had to pay all the costs; and the Company would take out of the concern £7500 in hard cash for their own purposes. Also it was common ground that a statutory company was worth more years' purchase than a non-statutory one. Lastly, he referred to the suggested deduction of £1000 on account of working capital.

The UMPIRE: I have never before seen a deduction made because the buyer will not have any working capital handed over.

Mr. HARRY JONES: Do you contend that you could no more make these profits without the money to provide coals and the men's wages than you could without the retorts?

Mr. HONORATUS LLOYD: Yes. It is part of the working stock of the Company. You could not get on without it. Continuing, he said the Council wished to pay fairly for the undertaking; but he did want the tribunal to bear in mind what was the history of the Company. The shareholders had subscribed £7700 in hard cash—that was including the premiums. The rest of the works had been built out of the ratepayers' pockets. It was quite true, of course, that the Company might, if they had liked, have raised the necessary capital and paid dividends on it. But they did not; and while paying 10 per cent. on the nominal capital, they went on building the works most successfully out of the consumers. Now it was suggested that this 7700 sovereigns had become worth not only £60,000, but £60,000 *plus* the £5700 that they were to take, *plus* all the costs. If the tribunal gave the shareholders a sum which would enable them to invest in as good a security, and with as good a prospect of receiving the same income, they would be doing them ample justice.

REPLY FOR THE COMPANY.

Mr. HUTCHINSON, in reply, said the undertaking had been built up, not from money taken out of the pockets of the consumers, but through the self-abnegation of the shareholders, who had abstained from taking the dividends to which they were legitimately entitled, and to the benefit of the community as well as their own undertaking were thereby enabled to supply gas at a price which was lower than that charged by any other undertaking of a corresponding size in the County of Derby. The Council were not forced to purchase; they became the buyers voluntarily. As to the additional supplies since the end of 1912, if Parliament had meant that the Company should have the bare cost of the necessary mains, and not the profit on the supply, would not Parliament have said so? Dealing with the valuations, he claimed that the evidence clearly established that repairs and renewals meant repairs and renewals, and did not mean depreciation. Both Mr. Allen and Mr. Bell very frankly admitted that in many instances what they had been charging for repairs and renewals, which had brought their figures up to an amount by which they sought to justify the 9d., was capital expenditure under another garb. Everybody admitted here on both sides that everything was well maintained; and there was no evidence of lack of repair. Then as to the amount put down for deficiencies, what had the Council's witnesses done? Their object really was to get a new works. Had they any right to reconstruct the works at the cost of the vendors, merely for the purpose of obtaining a better result? The foundation of an arbitration like this was that they must take the thing as it stood. Anything necessary to be expended on apparatus to maintain the income was a legitimate charge.

The UMPIRE: I do not doubt that I have to take the thing as it is.

Mr. HUTCHINSON next referred to the proposed deduction of £1000 for working capital. He said the working capital had been provided from funds in the hands of the Company which were their own property, and had to pass to them as such.

The UMPIRE: The question I have to decide is, Is the revenue maintainable at that figure, or will it be necessary for the Council to borrow money from the bank, and pay interest on it, which must be deducted?

Mr. HUTCHINSON: Is not the answer to that question: Parliament has said, "You shall take this undertaking over on these terms, and you shall find your own working capital"?

The UMPIRE: But it does not prevent me from considering the fact that they have to find their own working capital.

Mr. HUTCHINSON, after alluding to the omission from the Council's valuation of the sum of 5 per cent. for disturbance, &c., strongly urged that 25 years, and not 20, was the proper basis for purchase. The Chairman of the Council himself had placed it at 23 years.

THE CONWAY NUISANCE CASE.

Council to Appeal.

At the termination of a lengthy discussion, the Conway Town Council, at a special meeting held last Thursday, decided to lodge an appeal against the decision in the recent case [*ante*, p. 361, 448], when Mr. Albert Wood secured an injunction, with 40s. damages and costs against them, in respect of a nuisance which he alleged was caused by the operations at the gas-works. Six voted for the appeal and six against; and the Mayor (Mr. Edward Jones), who had not voted, then gave his vote in favour of the appeal, amid the cheers of the members of the general public present. A proposal to hold a public meeting to consider the matter was moved and seconded, but was not put; and a similar fate met a suggestion that an appeal should be made to all other corporate authorities for funds to further fight the case. It was pointed out that the Corporation were fighting, not only in the interests of their own ratepayers, but in the interests of all ratepayers, and for an authoritative interpretation of the law.

The meeting was held to consider a report by a deputation which had been appointed to interview Mr. Wood. This was to the effect that Mr. Wood had, at an interview, stated that, if the Council decided not to appeal against the judgment, he was prepared to agree that a letter written by him to the Mayor last March should be the basis for a settlement of his grievance against the Corporation. The requirements set forth by him were for the Council: (*a*) To brick up permanently the whole of the openings in the retort-house walls on the sides adjoining his property and the high road. (*b*) To close up entirely the ventilator in the roof. [The deputation asked if this meant both sides of the retort-house, and Mr. Wood said only on the side abutting on his property.] (*c*) To construct four or more ventilating shafts in the roof, of sufficient area to take the smoke and fumes when the retorts are drawn; such ventilating shafts to be at least 20 feet high above the present level of the roof. (*d*) To construct a new shaft for the retort-house, 80 feet high, so that all products of combustion would be carried up well above the level of the land, and so dispersed into the atmosphere. (*e*) To raise the boiler-shaft, or construct a new one of similar height to the new chimney of the retort-house. [As regards the last stipulation, Mr. Wood was asked whether this meant a shaft of 80 feet or a shaft of the height of the present retort-house chimney—viz., 38 feet. Mr. Wood replied 80 feet, or such height as might be agreed upon by the engineers.] (*f*) To pay all costs. [This includes such additional costs as have been incurred by Mr. Wood over and above the taxed costs in the action.]

Mr. Wood was asked whether, if the Council agreed to these conditions, it would be a final ending to the alleged grievance, and also if he would enter into an agreement binding himself and his successors that the carrying out of these clauses would end the dispute for ever. He said that, as far as he was concerned, it would end the dispute during his lifetime; but he had been informed that he could not enter into any agreement to bind his successors. Mr. Wood was asked, further, if he would sell to the Corporation a portion of his land adjoining the gas-works for storage and other purposes other than gas manufacture. This he emphatically refused to do. Asked if he would sell to the Corporation the small plantation or spinney adjoining the gas-works, he said he would not. He stated that the Corporation could not bind their successors that no part of any land sold by him would be utilized at some future time for the purposes of gas manufacture.

Increased Water Storage for Newport (Mon.).—A new service reservoir, constructed for the Newport (Mon.) Corporation at Beechwood Park, has just been inaugurated. It is an adjunct to the Wentwood works, and transforms the high-pressure supply from Wentwood into a low-pressure one for certain portions of the borough. The capacity of the reservoir is 500,000 gallons, and it has cost £3500 to construct.

TORONTO CONSUMERS' GAS COMPANY.

The Sixty-Fifth Annual Meeting of the Consumers' Gas Company of Toronto was held in that city on Tuesday, the 28th ult.—the PRESIDENT (Mr. A. W. Austin) in the chair.

In the report submitted, the Directors expressed their gratification at being able to lay before the stockholders a very satisfactory statement of the business and progress of the Company during the year ended Sept. 30. The output of gas for the twelve months amounted to 3,492,087,000 cubic feet, which was an increase of 372,339,000 feet over the preceding year. New services put in numbered 7903; and 36 miles of street-mains were laid. New plant having a manufacturing capacity of 4,000,000 cubic feet of gas per day is nearing completion; but the increase in the demand for gas is so rapid that the Board already find it necessary to consider plans for the further enlargement of the works, and for adding to the capacity of the distribution system. The Directors pointed out that, but for very favourable coal and oil contracts, made prior to the rise in market prices, the consumers could not have been supplied with gas at the extremely low rates at present prevailing in Toronto. Large increases made in the assessment of the Company's property for municipal taxes have necessarily added to the cost of gas. The Company have been authorized, by Supplementary Letters Patent, to extend their works and pipes and exercise their powers within the townships adjoining the limits of the city of Toronto and the limits of the township of York, and to sell the unissued shares of the Company's authorized capital stock, either by public auction or by tender. To provide the additional capital necessary for the requirements of the Company, 10,000 shares (having a par value of $500,000.00) were offered for sale by auction in June last. Of these, 6810 shares (having a par value of $340,500.00) were sold; the premium realized being $227,600.00. During the year under review, the number of meters in use increased from 82,022 to 91,284; and the gas-rental from $2,058,140.63 to $2,294,308.21.

The PRESIDENT, in moving the adoption of the report, remarked that he did so with a feeling of satisfaction, knowing it was one of which the Board, as well as the shareholders, might be proud. The year had been an eventful one; for it had been characterized by the greatest expansion of business in the Company's history. It necessitated a continuance of building and extension operations, in order to keep ahead of the tremendous demand for gas. The Company's record was, indeed, a very important page in the annals of modern gas manufacture, as well as its distribution. In comparison with other gas companies in America, they still had the lowest capital stock expended per mile; and, in proportion to population, most mileage. The plant necessary for a successful gas-works could not be erected in a short space of time. Consequently, they had to look far ahead, if they were to care for all the business that would likely be offered. To do this meant also financing ahead; and as the amount of capital required as the Company grew would be larger in proportion than in the past, with this fact before them it was a very important question for the Directors to consider in the coming year. It appeared to them that some means of disposing of stock, other than the present authorized modes of auction or tender, should be introduced. In the past, with smaller amounts of stock offered, the requirements were mostly met by auction sales; but experience of late had demonstrated that this method is not satisfactory. To give them an idea of how the rise in price of coal and oil would have affected the Company, had they not been fortunate enough to make favourable contracts in advance, he said it would have made a difference of more than $200,000 a year; and the Directors would undoubtedly have had to raise the price of gas, had they to pay current prices for these commodities. When he told them the Company would soon have 100,000 customers to take care of—more by about 20,000 than even the City Water-Works Department had at present—they would understand what it meant to read meters, get out accounts, and collect the money monthly. He desired to recognize the ability and fidelity of the General Manager (Mr. Arthur Hewitt), and the staff and employees—who now numbered about 1500.

The VICE-PRESIDENT (Mr. Wellington Francis, K.C.) seconded the resolution, which was unanimously carried.

BIRMINGHAM GAS-METER CONTRACTS.

The Gas Committee and Mr. Stevens.

When the nominations for membership of the Gas Committee came before the Birmingham City Council, at the quarterly meeting last week, Alderman Tonks moved as an amendment that Mr. Riley be elected in place of Mr. Stevens. He pointed out that at two meetings of the Council Mr. Stevens had made charges against the Committee, and almost specifically against the Chairman of the Committee; and the Council, after listening to him with great patience, decided against him. But since that time Mr. Stevens had again brought charges of jobbery and corruption against the Gas Committee—charges he failed to substantiate in the Council; and in the circumstances it seemed to him undesirable that Mr. Stevens should remain a member of the Committee. There was a long discussion, in the course of which it was urged that the Council should not penalize a man for speaking his mind. The Lord Mayor said he thought the one word objected to by the members of the Gas Committee was "jobbery." This word conveyed an impression of wrong-doing, which he was not at all sure Mr. Stevens ever intended. He did not think Mr. Stevens meant to attack the personal honour of his colleagues; and he felt equally sure if Mr. Stevens could see his way to withdraw this one word, his colleagues would be glad to work with him on the terms they had worked for many years. Mr. Stevens said that he had never charged the Com-

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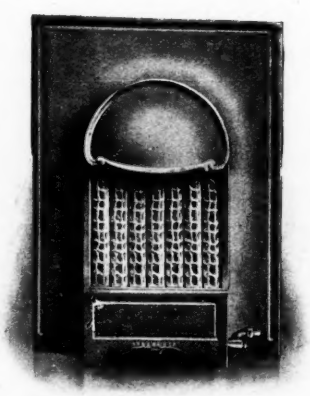

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mittee with corruption. The Council did not know of the abuse he had had from the Committee and officials, nor did they know of the charges of dishonesty made against him. If the Council did know of these things, they would look at the question in a different light. "What I do say," he added, "is that I have asked for an inquiry. This inquiry has been refused; and I withdraw nothing." Mr. Pepper said that he thought Mr. Stevens, at the last meeting, withdrew his charges against the officials. Unless Mr. Stevens was prepared to apologize to the Committee after what had happened on two previous occasions, he thought the Committee were justified in saying they did not wish to work with him.

Alderman Sir Hallewell Rogers remarked that he did not think the Council would expect him to submit to the statement by Mr. Stevens that he had been abused by the Committee and officials. Mr. Stevens had worked very hard and very loyally on the Gas Committee for some years, and in many ways; and he personally would be sorry to lose him. But in the circumstances it would be difficult for them to work together. Other members having appealed for the withdrawal of the word "jobbery," Mr. Stevens said he had charged no one with corruption. He had his own interpretation with regard to the words, which he still stood by. As a matter of fact, the Secretary of the Gas Department had told him (Mr. Stevens) that he had been "got at" by the meter manufacturers. This was a charge of dishonesty. Sir Hallewell Rogers retorted that Mr. Hilton's remark was not meant in an offensive way; but when he saw the interpretation put upon it, Mr. Hilton apologized in a most ample manner.

More unavailing appeals were made to Mr. Stevens to withdraw the words objected to, and then a vote was taken. Mr. Stevens was re-elected by 48 votes to 39; 26 members remaining neutral.

EXTENSION SCHEME AT WALLASEY.

The Growing Demand for Gas.

A Local Government Board inquiry was held by Mr. T. C. Ekin at Wallasey last Tuesday, regarding an application by the Council for sanction to borrow £40,200 for the extension of the gas-works, and £65,000 for the electricity works.

In support of the application with reference to the gas-works, Mr. H. W. Cook (the Town Clerk) said that the continued and rapid growth of the population of the borough necessitated an increase in the supply of gas, and a consequent increase in the plant. The present total safe carbonizing capacity was 2,750,000 cubic feet of gas per day of 24 hours; while the maximum day's output for the year ended March 31 reached 2,700,000 cubic feet—an increase of 200,000 cubic feet over the previous year's maximum. These increases were likely to be maintained in the early future. To March 31 the gas undertaking had contributed to the relief of the district rate the sum of £207,713. The Gas and Water Engineer had reported that the loan charges on the cost of the provision of machinery and the extension of the carbonizing plant would be met without detrimental effect on the working costs of the undertaking. In fact, there would be at first a small credit in favour of the expenditure, and this would increase with the increased output of gas.

Evidence was given by Mr. W. S. Chantrell (the Chairman of the Gas Committee) and Alderman Swanwick (the ex-Chairman), to the effect that the loan was absolutely necessary to provide for the demand there would be for gas in the borough over the ensuing ten years, and that the expenditure would enable the Committee to supply gas at a less charge than at present, and yet meet all the demands.

Mr. J. H. Crowther (the Gas and Water Engineer) said he hoped to have the new works in use twelve months from now. The greatest consumption of gas was between 11 and 1 o'clock on Sunday, when cooking went on more extensively than on any other day of the week. The output had doubled in the past decade.

There was no opposition to the application.

ILKESTON GAS UNDERTAKING.

The newly-elected Mayor of Ilkeston (Mr. J. A. Macdonald), who, as a member of the Gas Committee, has taken a particularly active part in matters relating to the management of the Corporation undertaking, directed attention, at the recent statutory meeting of the Council, to several points of interest connected with this branch of municipal enterprise. He explained that the Corporation had a capital of £115,000 invested in the concern, and so successful had been the working results that they had been able to pay off about £55,000. Since the disaster which occurred at the works at the beginning of 1912, the Committee had not been in a position to hand over any money in relief of the rates; but during the two years they had accumulated £5500, after meeting everything in the way of interest, sinking fund, and allowance for depreciation, repairs, renewals, &c. In addition to having this amount in hand, they had, as a result of excellent reorganization which had been effected in regard to financial arrangements by the Town Clerk, been able to utilize £2900; so that there now stood to the credit of profit and loss account £8400 available for distribution. This demonstrated that there was a considerable amount of vitality in the undertaking, despite the difficulties which had had to be encountered. It was estimated that during the present year a profit of £2500 would be made, and in the following year upwards of £3000. At the end of March next, the Committee would, it was anticipated, be in a position to hand over either £2500 or £3000 in relief of the district rate; this being equivalent to 8d. or 10d. in the pound. They were fortunate in having in control of the undertaking an excellent official with sound business ideas; and they were now getting 11,000 instead of 10,000 cubic feet of gas out of a ton of coal, without detriment to illuminating

"ADAM," with Back and Hood.

Artistic Perception

A great change has been taking place in the artistic perception of the Public—an extraordinary improvement has manifested itself in every section of the applied arts. Architecture, Furniture, Wall Papers, Fabrics, Panelling, Ornaments have all been vastly improved. Artists have been busily engaged reproducing and adapting to modern requirements the best designs from those periods when arts and crafts were at their best. The trend to-day is all for good design and utility.

THE RICHMOND GAS STOVE

Gasfire

WARRINGTON

power or to the value of residuals. There had been a period during which 11 per cent. of all the gas made was lost—representing a sum of £1600 a year. But the Committee were determined to see if this leakage could not be lessened; and they hoped to reduce it within the next two years to 5 per cent. of the whole output. They would then pick up £800 a year, which would pay interest and sinking fund on £12,000.

HUDDERSFIELD GAS-WORKS RESULTS.

At the Council Meeting of the County Borough of Huddersfield, yesterday week, the Mayor (Alderman Joseph Blamires, J.P.) was unanimously re-elected for the ensuing year, upon the proposition of Alderman William H. Jessop, J.P., seconded by Councillor George Thomson, J.P. (Deputy-Mayor).

Among the departmental reports submitted by the Mayor to the Council was the following by the Engineer and Manager of the Gas Department (Mr. Edward A. Harman, M.Inst.C.E.): The quantity of gas sold during the year ending March, 1913, amounted to 869 million cubic feet, showing an increase of 19 millions over the record output of the previous year. No addition has been made to the capital account since the year 1897. The total number of gas consumers is 31,189—an increase on the year of 617. The Committee have had a very anxious time during the year, owing to the enormous increase in the cost of coal following upon the railway strike and the national coal strike; but having regard to the balance in hand in the contingencies fund, no increase has been made in the charges for gas. The penny-in-the-slot prepayment system continues to maintain its remarkable popularity; the amount of money collected last year being £29,028. From the commencement of the system in 1897, over £266,937 has been collected. The National Gas Congress and Exhibition just concluded at Shepherd's Bush has proved to be an epoch-making event in the history of gas supply. It has been a revelation to many to learn the numerous uses to which gas is applicable, and how many industries are totally dependent upon it. Gas is used for cooking in almost every household in the town; and it is hoped that, owing to the great improvements in the appearance and the effectiveness of the modern gas-fire, the use of gas for heating in the near future will be as general as it is for cooking, if for no other reason than the very great abatement of the smoke nuisance which is accomplished by each and every use where gas is burnt instead of coal. The realization of the great difference this general use of gas will bring about assures a prosperous future for the gas-supplying department.

The South Cliff Water-Works Company has been registered, as a private company, with a capital of £3000 in £1 shares, to adopt an agreement relating to the supply of water on the South Cliff and Meadowfields estate and road and surrounding districts.

GAS AND ELECTRICITY AT TEIGNMOUTH.

A report was presented to the Teignmouth Urban District Council last Tuesday by Mr. J. A. Gray, the Gas Engineer and Manager, on the probable effect of the introduction of electric lighting. The Council recently had before them a report by Mr. E. M. Lacey, M.Inst.C.E., in which it was estimated that the provision of plant for an electricity undertaking would cost £20,800. Mr. Gray pointed out that, in view of the rapid and continuous growth of the business of the gas-works, it had become necessary to consider the question of additional storage; the maximum daily output of gas being in excess of the total storage. A gasholder of 200,000 cubic feet capacity would double the storage, and cost about £5520, or one of 100,000 cubic feet capacity would come to £3000. The cost of extending the coal-store and widening a railway bridge would be £1200. In order to supply gas to Shaldon, which is in the area of the District Council, but separated from Teignmouth by the River Teign, an expenditure of £2354 would be necessary. An electricity supply undertaking would have very little prospect of deriving revenue from sources other than those from which the gas undertaking was supported. If Mr. Lacey's estimate of a total sale of 195,200 units per annum to ordinary consumers and a revenue of £3800 from Teignmouth users was realized, the finance and future of the gas undertaking would be very seriously affected. If the electricity scheme was accepted, and justified its adoption, the suggested expenditure for extending the gas-works would be avoided; and the chief anxiety of the Gas Committee would be to further the consumption of gas in order to retrieve the position. The introduction of electricity would not, however, adversely affect the gas industry to the full extent indicated by the expert's report. Neighbouring towns supplied gas at higher rates than Teignmouth, and yet were able to maintain a reasonable position, notwithstanding the competition of electricity at 5d. per unit. It was not difficult to prove that an equal amount of electric illumination at 5d. or 6d. per unit could not be provided at the same cost as gas illumination at 3s. 1d. per 1000 cubic feet. The Chairman (Mr. W. B. Harris) pointed out that the question of erecting electricity works was important to the town, as it would seriously affect their borrowing powers. As to the effect on the revenue from the gas-works, last year their receipts from private consumers were £5274. The Electrical Engineer estimated that the revenue from electric lighting would be £2450, which would at once make a hole in one-half of their income; for he did not think the ratepayers and consumers of gas were going to increase their expenditure on lighting by 50 per cent. After further discussion, it was decided to defer consideration of the matter for a month, with a view to obtaining additional information.

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COMBINATION OF GAS AND ELECTRICAL INTERESTS.

Mr. Jacques Abady Looks Forward.

Recently "Meteor" of the "Electrical Times" had a note touching a reference of ours to the subject of co-operative work by the gas and electrical interests. Mr. Jacques Abady considered our journalistic friend's comment neither witty nor sensible; and he wrote to the "Electrical Times" to that effect. Having got rid of his frank expression of opinion, he proceeded:

I do not think it was many months ago that Mr. Wordingham addressed a communication to the "JOURNAL OF GAS LIGHTING" advocating a union of gas and electrical interests, instead of constant warring; and the same thought must, I am sure, have often occurred to those of us whose habit of mind or whose business interests direct us neither into the *pro*-electrical nor *pro*-gas camps.

May I venture to repeat what I said at a recent conference on the prevention of smoke, that the whole essence of smoke prevention, of economy in duty from coal, and in the salvage of the valuable bye-products obtained from coal, lies in the combustion of coal, not in open furnaces as under a boiler for steam-making or in a domestic grate, but in the destructive distillation of coal on lines akin to those applied in a gas-works?

I generally assume that a trade paper serves up its matter in a form which is likely to tickle the palates of its readers; and if "Meteor's" paragraph that I refer to has this intention, it certainly appears to me that electrical engineers cannot have considered the immense possibilities of a combination of gas and electrical interests, from a commercial, from an economic, and from a point of view of the social betterment of the public.

The immense possibilities that lie behind the universal production of electricity by coal which has been gasified, both in respect to the above considerations and in respect to the facility of dealing with varying load factors, appear to me to be worthy of the serious consideration of the very eminent engineers who direct both the electrical and the gas industries.

I believe myself that the present method of gas-making has only touched the fringe of its economical possibilities, while I also think that the usual method of generating electricity is not only wasteful, but almost barbarous in its crudeness.

I have not by me the article by Mr. Wordingham to which I refer, but I am not without hopes that one of these days an engineer of his eminence might be able to bring about some sort of consideration of the *pros* and *cons* of a *rapprochement* such as I suggest. I am very certain that it is upon these lines that progress in the supply of light, heat, and power must ultimately lie. The intensity of my conviction on this point is the reason why I take it upon myself to address you on the subject.

THE COKE QUESTION.

By ROBERT WATSON, of Doncaster.

[From the November Issue of the British Commercial Gas Association's "Bulletin."]

Mr. Allen, in his presidential address before the British Commercial Gas Association, announced that a Coke Committee had been formed for the purpose of drawing the attention of the public to the value of coke as a good, smokeless fuel, and inducing gas undertakings to put it on the market in a condition best suited to the requirements of customers. That Committee having been recently constituted obviously needs a little time to formulate some scheme or plan of campaign calculated to do efficient work.

There is, however, no necessity to await the general recommendations of the Committee as to the use of coke for industrial, domestic, and other purposes. The winter is upon us; and the purpose of this prefatory note is to suggest to those gas undertakings who have as yet taken no special steps, that they may at once help in the solution of the problem of coke disposal by cultivating a purely local coke trade.

The British Commercial Gas Association has been doing, and reasonably hopes to do, considerable work in encouraging the use of gas in every conceivable walk of life. It is obvious that the increased gas sales following such progressive work must necessitate the employment of a larger quantity of coal, and the consequent production of greater quantities of coke. When the manager forgets that he is a gas engineer, and remembers his responsibilities as a producer and seller of bye-products, he more than ever realizes how difficult a task he has to find an ample market for the latter, and at such prices as will keep down the cost of the gas sold by his other self. The fact that, unless he is successful as a "residuals" merchant, the price of gas—and the hope of increased sales—may be affected to the extent of a few pence per 1000 cubic feet, makes him the more anxious.

Although the propaganda work of the British Commercial Gas Association and of the gas industry as a whole may accentuate difficulties as to the disposal of residuals generally, there should be no great need for fear if gas undertakings spare some of their energy in maintaining and enlarging the present market.

What is the task before the industry, so far as coke is concerned? The carbonization of gas coal this year can be estimated as 16,800,000 tons; and from this will be obtained some 8,400,000 tons of gas coke for disposal within the year. Carburetted water gas production in the ordinary way would require about 560,000 tons—thus reducing the figure to (say) 7,840,000 tons.

The recent partial shutting-down of carburetted water-gas plants, due to high oil prices, has, unfortunately, increased this quantity. To what extent this could occur is realized when it is remembered that the total disuse of carburetted water-gas plants and the necessary sub-

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stituted use of coal would mean an immediate increase of 1,600,000 tons of coke, for which a further market would have to be found.

Happily, there are signs that the limitation of carburetted water gas production is not going to be so great as was feared; and it is possible that the full normal working of carburetted water-gas plants may soon be resumed from well-founded and perhaps obvious motives of policy and finance.

While the quantity of 7,840,000 tons of gas coke seems in a sense formidable, in actual fact there should be no great difficulty in its disposal. The statutory undertakings of the United Kingdom probably have at the present time 7,500,000 gas consumers. Adding to these non-gas users and country customers, the quantity of coke for disposal works out to the insignificant item of well under 20 cwt. per house per annum; and this figure is very greatly discounted by the considerable usage of coke in the various industrial processes of the country.

I believe that when the possibilities of gas coke as a good smokeless heating agent are more closely brought to the notice of the general public—manufacturers and ordinary householders alike—great benefit will accrue to gas undertakings generally. But we must all work together, so that apathy, with consequent heavy coke stocks, in one district is not discounting well-planned propaganda exertions in another.

There are many fields for coke usage. The trend of legislation is towards the compulsory abolition of smoke, and this should and will draw the attention of many manufacturers to smokeless fuel. Having such an agent, the time is distinctly opportune for the gas industry to engage in its advocacy.

While the recently appointed Coke Committee are giving their attention to the matter generally, gas undertakings, who have as yet done nothing, could very materially help their labours, and primarily their own profits, by doing the very necessary work of fostering local trade by paying special attention to the coke they are supplying, and particularly for domestic use.

The preparation and grading of a good dry broken coke for domestic, smithy, and other purposes, a little systematic local advertising, and careful attention to orders, will do much in the way of reducing coke yard stocks. Many members of the various Commercial Sections have done a great deal in this direction, and can testify to distinct increases in local coke sales, with consequent improvement in the average price realized for this residual. *Verb. sap.*

Reduction in Price at Connah's Quay.—The Directors of the Connah's Quay Gas Company have decided that, as from the 1st ult., the price of gas to ordinary consumers would be reduced from 4s. 3d. to 3s. 11d. per 1000 cubic feet. No difference will, however, at present, be made to the users of prepayment meters. It is said that the reason for the concession is that, owing to economies effected in production and the increased number of consumers, the Company are in more favourable circumstances, and the Directors desire that their customers should benefit accordingly.

EARLY DAYS OF GAS IN AMERICA.

Richmond (Va.) the Pioneer Gas Consumer.

The few particulars given in the last number of the "JOURNAL" (pp. 533-4) in regard to the gas supply of Richmond (Va.), the meeting place of the American Gas Institute this year, may be supplemented by the following extract from the local press, reproduced in the current issue of "Gas Institute News."

Ever in the lead, Richmond can truthfully boast that it was the pioneer gas consumer in America, notwithstanding the claims of several large cities to that distinction. In 1803—twenty years before this mode of illumination was introduced in New York, thirteen years before Baltimore saw the new light, seven years before the first known gas company was organized, and four years before the first public exhibition of street lighting was given in Pall Mall, London—Main Street, near Eleventh Street, was brilliantly lighted by a huge gas-lamp erected on a 40-feet tower. The previous winter, Benjamin Henfrey came to this city and advertised that he would exhibit his new invention, "inflammable air." The admission was 50 c., and thousands of persons visited Hay Market Garden to witness the wonderful sight. The "new light" was made in a tea kettle from wood and pit coal. In order to satisfy the people that the demonstration was not a fraud, a Committee of the most prominent Richmonders of the day were called in to witness several experiments. At the conclusion of their report, they said: "We are decidedly of the opinion that gas produced from pit coal yields a more mild and uniform light than that from wood; and, by comparison with the light from animal oil and tallow, it appears to us, as it proceeded from a tube about one-fourth inch in diameter, to be nearly in proportion of 1 to 20. We have witnessed with pleasure the gas applied to cooking purposes. The apparatus is on a simple plan, and is not expensive."

Henfrey was attacked in the newspapers as a fraud, on account of the claims he made for his "new light;" but, in spite of this, a subscription was started to build an octagon light tower. A few months later it was erected. Forty feet above the ground was the large lantern, which had many jets, all fed from a still in the cellar, in which the gas was generated. The first night large crowds came out to see the light. It was successful at first, but did not last long; and Main Street went back to animal oil lamps.

The next time the question of lighting the city with gas was agitated was in 1845, when the Council approved a Charter to incorporate a company for the purpose, and subscription-books were opened on Feb. 6, 1846. The people demanded light, and the Council then ordered an election to decide whether the gas-works should be owned by the city or by a private company. A vote was taken on April 2, and, by a majority of 61 out of a total of 855 ballots cast, the people decided on a municipal plant; and to this day Richmond has controlled the gas situation.

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METROPOLITAN WATER BOARD.

The Deficiency Rate.

At the Meeting of the Metropolitan Water Board last Friday, consideration was given to a letter received from the London County Council on the subject of the Board's accumulated deficiency. The Council pointed out that, under the procedure adopted by the Board, the deficiency would always be two years late, so far as raising the money was concerned. The Council considered that it should be made clear that the deficiencies for 1912-13 and 1913-14 were covered by the Board's rating powers; otherwise questions might be raised again as to the authority of the Board to precept for more than one year's deficiency in any year. Should the deficiency increase, the ratepayers for the time being would escape part of their legitimate burden unless the rate was levied in the year in which the deficiency arose. The Council suggested the desirability of raising the deficiency as it arose. On this the Finance Committee reported that the Board were entitled to raise by precept £209,572, and to this had to be added an approximate additional deficiency—making the net amount £243,942. The Committee recommended that, while reserving any powers enabling them to levy precepts for estimated deficiencies, in view of the recent demands it was inopportune to ask the contributory authorities to meet in one financial year precepts in respect of the realized deficiency for the year ended March 31, 1913, and the estimated deficiency for the year ending March 31, 1914. The recommendation was agreed to.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

There ought to be a good attendance of the members of the Eastern District of the Scottish Junior Gas Association at the quarterly meeting to be held at Perth on the 22nd inst. The papers to be read are as follows: "The Purification of Coal Gas," by Henry Doran, of the Granton Gas-Works, and "Notes on Sulphate of Ammonia Manufacture," by Mr. A. R. Wilson, of Perth. Opportunity may also be taken to have the discussion that was postponed, on account of his indisposition, of the address by Mr. Geddes, the President, at the recent meeting in the Heriot-Watt College.

The visit to Cambuslang of the Scottish Junior Gas Association (Western District) was in every way satisfactory. A large attendance seems to be the invariable rule; but on this occasion it was, perhaps, larger than usual, on account of the prospect of seeing the latest installation in Scotland of Glover-West vertical retorts. There is no doubt that, at the moment, the erection of vertical retorts is exercising the minds of gas engineers all over the country; and there is need to warn some that there is good work still to be done by horizontals, and that verticals are not the only retorts by which gas can be made economically. Especially is this the case where foundations are not of the best, and particularly so where underground workings are to be found; as the considerable weight upon a small area requires that the subsoil upon which the retorts are to be placed should be stable, or endless trouble will be occasioned. Evidence is to hand that these verticals are in contemplation in Kilmarnock, where there is talk of scrapping the horizontals and electrically-driven charging machinery at a comparatively early date. Also at Hamilton, where the specifications and inquiries are already prepared. The installation at Cambuslang consists of sixteen retorts, each capable of a production of about 31,000 cubic feet per day; so that, for present requirements, there are only about twelve to fourteen retorts needed. The place where these retorts have been erected was originally planned for an extension of the horizontal retorts formerly in use, and which, if not scrapped, are lying idle and earning no dividend. The walls surrounding the new retorts have been built of 4½-inch bricks in panels made of H beams, fixed inside the former retort-house walls, and not resting upon them. But there is a point which strikes one as having been lost sight of—namely, the utilization of the position of the works, which lie in a hole, to bring the coal in at the higher level, so as to avoid its elevation by means of power. A high-level cart-road would have enabled the bringing in of this coal, which is entirely carted, so as to have reached the works at the level of the hoppers; and thus a constant expense might have been saved. The arrangements generally seem very well designed, and reflect credit upon Mr. Simpson, who was untiring in his desire to explain everything to the visitors. He was, however, loth to give figures at present, in view of the short time he has had the installation at work. In this he was very wise, as many engineers are anxious to speak of the advantages of new plant long before they have had proper experience of its working.

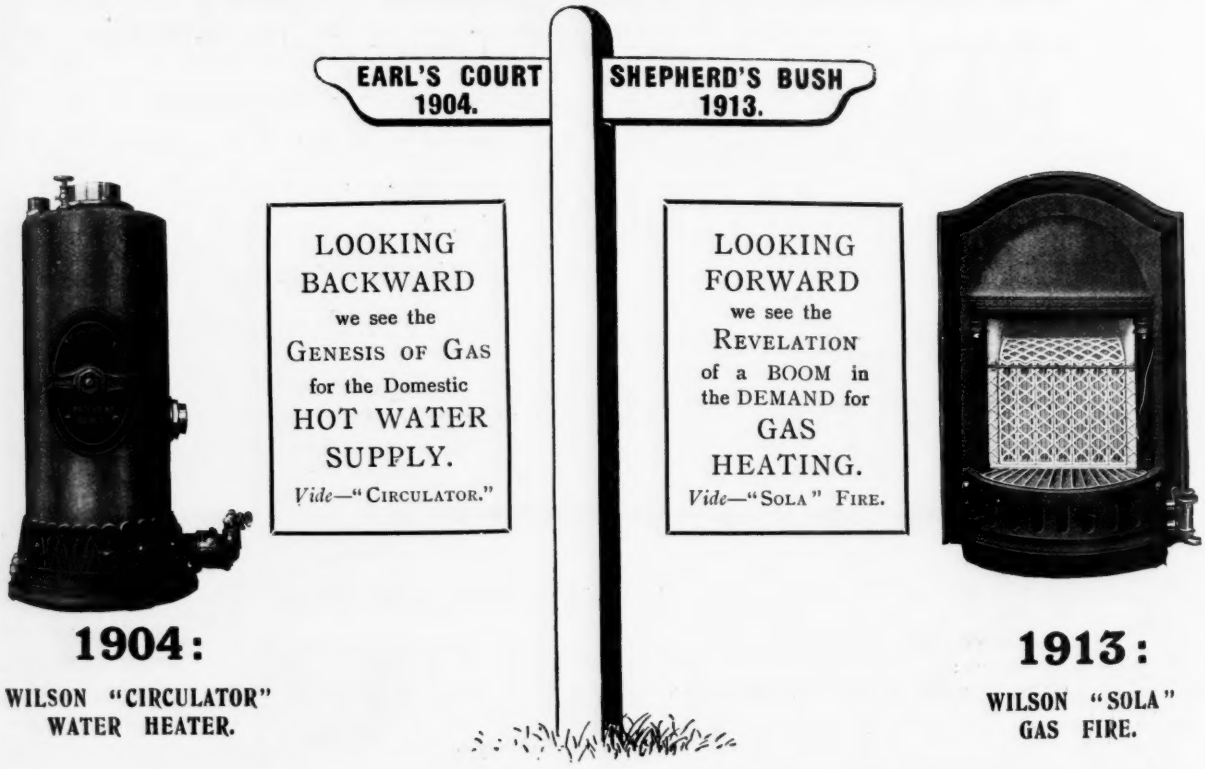
At Tillicoultry, the automatic street lighting has now been made satisfactory; and it is stated that the trouble had nothing to do with the apparatus.

The Finance Committee of the Lanark Town Council state that the gas loans have been arranged; but still there is no statement as to the rate of interest payable. They also say there is no intention at present of altering the price of gas. This has been decided upon after considering the last report of the Company, whose property the Town Council acquired. It is pointed out that the reason of referring to this question is that the Finance Committee wish it to be recorded that they had had it under consideration, in view of possible subsequent events.

Kirkcaldy is to apply for a Provisional Order to do certain things—among others, to increase their area of supply in the parishes of Kinghorn, Auchtertool, Kinglassie, and Markinch, and to define the limit within which the Corporation may supply gas under various Acts from 1847 to 1893.

Dunfermline has resolved to extend their pipes in the Torryburn

The FINGER-POST of PROGRESS.



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district to supply 100 houses about to be erected at Crombie, near the entrance to the Admiralty works there. The price is to be 3s. 9d. per 1000 cubic feet. It seems that some 400 houses are to be built in this neighbourhood later on; so the extension of the main should be a profitable undertaking. The Dunfermline Gas Department are likely to benefit largely in the near future by the advent of the Admiralty and their huge undertaking at Rosyth, which will also be of considerable value to the Gas Company at Inverkeithing, whose property the Council there are again anxious to acquire. The prospects of the Company have greatly increased since the Town Council first proposed to purchase the concern some few years back; and the price to be paid will be a very different one now.

Councillor Stevenson, the Convener of the Edinburgh Electric Lighting Committee, has been addressing the Merchants' Association, and pointing out how cheap coal has kept the price of electricity low, and that as Edinburgh is a "show place" the merchants have quickly recognized the advertisement of good lighting. This applies also to gas lighting, as do many of his remarks upon the advantage in improved atmosphere of using electricity in place of coal for heating. Edinburgh has recently been visited with a few days of thick fog, so that the remarks of Councillor Stevenson are particularly opportune. However, no amount of preaching will induce the community to adopt new methods which will be for the benefit of the public generally, unless it can be shown that, at the same time, it will be a pecuniary benefit to the individual. If electricity for heating were cheaper than coal (which it certainly is not), then it would be at once adopted, and the air would be purified. Gas in the past has been dearer than coal for heating; and it is difficult to induce the lay consumer to believe that it is not still a more expensive and less healthy method of supplying the necessary heat for a room. Exhibitions do much to show the appearance and heating power of gas-stoves; but there is little effort generally made to prove to the public that the consumption of a stove is such that the cost can be easily estimated for a room of any given size. Thus, if it were shown that a 14-inch stove, suitable for an ordinary room of 3600 cubic feet capacity, could be used for less than 1d. per hour, when all the burners were full on, and for slightly over ½d. per hour when only the centre six jets were burning, this would prove to the public that the cost was not so deadly as is generally supposed. The question of consumption of a gas-stove is frequently hidden from the consumer when purchasing or hiring is in question; and it is left for him to find it out when the stove has been fixed and alight for some time. If then his gas bill has increased to a greater extent than he expected, the stove is removed, or at least the consumer is dissatisfied. All this could have been avoided if a meter had been used to show the consumption of the stove.

A Scottish gas manager has been complaining that many of his brother managers give so much of their business to English firms, in preference to keeping orders for their own local manufacturers. Scotland can certainly hold its own as regards most of the requirements of gas companies—notably in the manufacture of meters, governors, fittings, stoves, and many pieces of apparatus. There are also several excellent firms who make the larger necessaries—in the form of gasholders, purifiers, scrubbers, condensers, and the like. In fact, if he desired to do so, there would be no difficulty for the Scottish gas manager to obtain the greater part of his requirements from Scottish firms. One reason why he does not do this is because the English firms advertise more, and keep their products more in the public eye. Reports of the working are also more frequently given from English than Scottish works, so that the manager, be he Scottish or otherwise, knows better what he is obtaining and the probable results of its installation. It is a good general rule to adopt to keep, as far as possible, the business in the country where the apparatus is to be used; so that, where other things are equal, orders should be given locally.

Mansfield Gas and Water Undertakings.—According to a statement recently made by Mr. T. Smith, the Chairman of the Gas Committee of the Mansfield Corporation, among the chief work proposed to be carried through next year will be the extension of the gas undertaking, of which Mr. W. J. Rendell-Baker is the Engineer and Manager, upon entirely new and up-to-date lines. The provision of increased reservoir accommodation has also been taken in hand; so that the projected early expenditure on works of water as well as gas supply is likely to run into substantial figures.

Winding-Up of Porhydrometer, Limited.—Four years ago, a Company was formed, with a capital of £860,000, in £1 shares, to manufacture and deal in "porhydrometers," &c. The appliance named was duly described in the "JOURNAL." Last Friday, a meeting of the shareholders was held, at which a winding-up resolution was passed by seven votes to four. Mr. H. Houlder stated that at a previous meeting a suggestion was made that the Directors should endeavour, if possible, to reconstruct the Company. They had met several times; but, in the absence of a sufficient volume of inquiry for the porhydrometer, they had been forced reluctantly to come to the conclusion to wind up.

Wokingham Corporation Gas Undertaking.—Speaking at a complimentary dinner given to the ex-Mayor of Wokingham on Monday last week, the guest of the evening stated that when the Wokingham Gas-Works were bought by the Corporation they were valued at £6000. At that time the price of gas was 6s. per 1000 cubic feet, and coal cost 8s. a ton less than was being paid now. The works had been brought up to date; and most of the loans had been liquidated. Next year the last £500 would be paid off the large loan, and the undertaking would then be better off by this amount annually. The profit on the works last year was £1695, and the price of gas had been steadily reduced until it had reached 3s. 4d. per 1000 cubic feet. There had also been installed sulphate of ammonia plant at a cost of £360, the whole of which had been paid for by the sale of the product. There had been an increase in the output of gas every week; and since March the total amounted to 2 million cubic feet compared with the corresponding period of last year.

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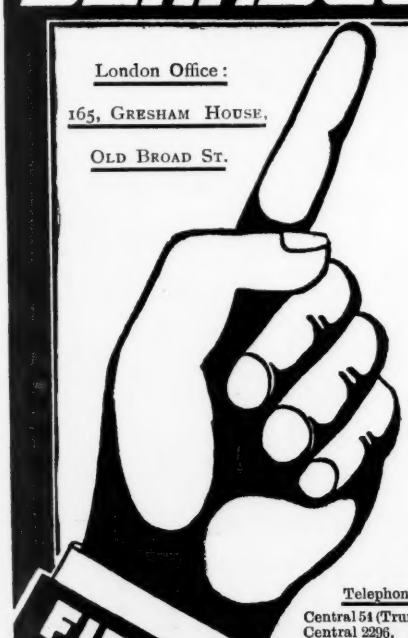

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CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 15.

Sulphate of Ammonia.

In the early part of the week the tone of the market remained firm, and full values continued to be paid for early delivery, but towards the end of the week the demand has fallen away, and prices are again inclined to recede. The nearest values at the close are £13 per ton f.o.b. Hull, £13 1s. 3d. per ton f.o.b. Liverpool, and £13 2s. 6d. per ton f.o.b. Leith. There is no new feature to comment upon in the forward position. Most of the manufacturers still require about £13 10s. per ton f.o.b. at the principal ports for delivery over the early months of next year, which price is quite unobtainable at present; in fact, speculative sellers are reported to be offering abroad at 2s. 6d. per ton advance on prices current for November shipment.

Nitrate of Soda.

This market is still dull, but holders on spot maintain quotations at 10s. 7½d. per cwt. for ordinary, and 10s. 10½d. for refined quality.

LONDON, *Nov.* 17.

Tar Products.

The markets for tar products remain fairly quiet, and on the whole business is somewhat difficult to arrange. In pitch, there has been a further slight reduction during the past week; and a fair amount of business has been transacted at the lower prices. In many instances, distillers have shown much more willingness to sell; in fact, they have sold during the past week a considerable quantity for delivery up to June next. Benzol, 90 per cent., maintains its price; and it is doubtful whether any lowering in value will be seen for some time to come. Solvent and heavy naphthas are quiet, with prices about the same.

The average values during the week were: Tar, 28s. to 32s. Pitch, London, 41s. to 42s.; east coast, 40s. 6d. to 41s.; west coast, Manchester, 40s. 6d. to 41s.; Liverpool, 41s. to 41s. 6d.; Clyde, 42s. to 42s. 6d. Benzol, 90 per cent., naked, London, 1s. 1d. to 1s. 1½d.; North, 11½d. to 1s.; 50-90 per cent., naked, London, 1s.; North, 11d. Toluol, naked, London, 10½d. to 11d.; North, 10¾d. to 11d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 5d. to 5¼d. Solvent naphtha, naked, London, 10¼d. to 10¾d.; North, 9¼d. to 9¾d. f.o.b. Heavy naphtha, naked, London, 10d. to 10¼d. f.o.b.; North, 9d. to 9½d. f.o.b. Creosote, in bulk, London, 3⅜d. to 3½d.; North, 3d. to 3⅛d. Heavy oils, in bulk, London, 3⅜d. to 3¾d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 0½d. to 1s. 1d. Naphthalene, £4 10s. to £9; salts, 55s. to 60s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit; "B" quality, nominally ¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

Business has been very quiet in this article during the past week, and not many contracts of importance are reported. The tender parcels have not been going quite so well, and, if anything, the market shows a downward tendency. Outside London makes are quoted at £12 5s.; Hull, £12 18s. 9d. to £13; Liverpool, £13 1s. 3d.; Leith, £13 2s. 6d.; Middlesbrough, £13.

COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade is on the whole quieter, though for very prompt delivery some classes of coal are steady. The output is large, but is well taken up. In the steam coal trade, best Northumbrians are about 14s. 6d. to 14s. 9d. per ton f.o.b., according to the time of delivery. Second-class steams are 13s. to 13s. 6d. per ton; and steam smalls are easier at 6s. 6d. to 8s. 3d. per ton f.o.b., according to the quality—the shipments to some of the Baltic ports showing a falling off of the latter kind. In the gas coal trade, there is a strong demand generally; and with steamers arriving freely at the coal ports, the shipments have been heavy of late. Best Durham gas coals may be quoted at 15s. 3d. to 15s. 6d. per ton f.o.b. for prompt delivery; second-class qualities are from 14s. per ton; and "Wear specials" are about 15s. 6d. to 16s. per ton f.o.b.—the latter kind being at this season in full request. The inquiry for all classes of gas coal is very keen for prompt delivery; and as the long contracts take up a large part of the production, prices are very firm for the surplus. No new contracts are reported of late; but cargoes of gas coal are being sold, for Genoa and other ports of the Mediterranean, on the basis of current values, though lower freights are now becoming more general. Coke is firm. Gas coke is in good request; but the production is heavy now. The price is from 17s. to 17s. 6d. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

The Scotch coal trade continues to have a very firm tone; and with the abundant tonnage that is available, the stocks are practically all disposed of for nearly three weeks in advance. On Friday, on the Glasgow Coal Exchange, the following were the approximate prices quoted: Ell, best brands, 13s. to 13s. 6d.; splint, 13s. 3d. to 16s. 3d.; navigations, 15s. to 17s.; steams, 13s. to 14s.; Hartley, 16s. to 16s. 6d.; trebles, 13s. 3d. to 13s. 6d.; doubles, 12s. 3d. to 12s. 6d.; singles, 10s. 6d. to 11s.; pearls, 9s. to 9s. 3d.; dross, 8s.—f.o.b. Glasgow.

Newry Water Supply.—In connection with the legal proceedings by the Trustees of Camlough Lake Water-Works, suppliers of the town of Newry, against the Armagh County Council, in respect of the alleged pollution of the lake by surface water, and the undertaking given in Court that the Rural District Council would be asked to have a diversion made, the latter body at their last meeting agreed to a proposal by the County Surveyor (Mr. R. H. Dorman) to have the work carried out. Mr. Bell, the Clerk, reminded the Council that they had the opinion of learned Counsel that they were legally responsible for preventing this water from going into the lake.

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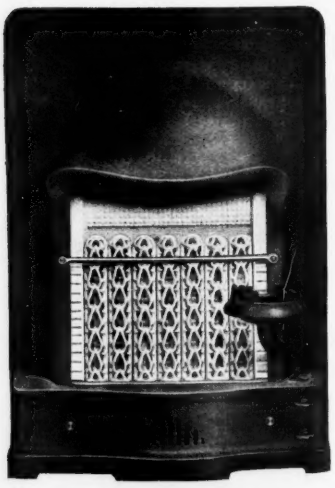

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High-Pressure Lighting at Hove.

The minutes of the Lighting Committee which were confirmed at the first meeting of the newly-constituted Hove Council contained a recommendation that certain permission asked for by the Brighton and Hove Gas Company be granted. Mr. Joseph Cash, the Engineer and General Manager of the Company, had written, stating that the Directors had instructed him to carry out a scheme of facia lighting for certain shops with the improved high-pressure lamp shown at the recent Gas Exhibition Immediately in front of these shops were five lamp-posts fitted with ordinary incandescent burners; and he asked the Committee to allow the Company to remove the lanterns from these lamps and replace them by Keith high-pressure lamps. The Company, he said, would remove the lanterns and replace them at the end of six months, and would supply the gas, maintain, light, clean, and extinguish during this period at the same price as was being paid for the existing lamps. Thus the Corporation would be put to no expense, and would have the advantage of the improved light during the period of the experiment.

Electric Light Failure at Todmorden.—Considerable inconvenience was caused to local tradesmen at Todmorden last Thursday through the fusing of one of the electricity mains, and the consequent failure of the supply of current. Tradesmen whose premises were lighted by electricity were compelled to resort to the use of candles, much to the annoyance of themselves and their customers; while those who used gas were in the fortunate position of being able to continue their business. For about half-an-hour the shops affected by the failure were in semi-darkness; and two local newspaper offices were also hampered in the publication of their journals through the stoppage of their electrically-driven machines.

No Coke-Oven Gas for the Rhondda.

It may be remembered that some weeks ago attention was called in the "JOURNAL" to a project for the supply of coke-oven gas to the Rhondda Urban District Council, from the works of the Cambrian Combine at Llwynypia, at the price of 7½d. per 1000 cubic feet. Correspondence on the subject ensued in the local papers, and Mr. Albert R. Cawley wrote to the "Western Mail" to point out that the offer was for gas delivered to the Council at the works of the Combine; and therefore the corresponding figure to the 7½d. was the cost of gas at the Council's works as stored in the holder, less receipts for residuals. He went on to say that, before a comparison could be made of the two prices, information on the following points was necessary: (1) Calorific power of the gas in British thermal units per cubic foot. (2) Illuminating power in sperm candles, and the number of the test-burner (whether No. 1 or No. 2) employed. (3) Chemical analysis of the gas. He also thought information should be given as to whether the heating and illuminating power of the gas were permanent, and whether the gas would bear transmission to the extreme ends of the district without depreciation. The effect of the correspondence was to force the General Manager of the Combine to state that the calorific power of the gas was not then known, but that it would be ascertained and forwarded to the Council. The illuminating power, it appears, has never been given, although something was said about it being 16-candles nominal. But, judging from other places in South Wales, the latter may be put at 6 candles and the former at 350 to 400 B.Th.U. per cubic foot. However, according to announcements in the Cardiff daily papers, the project has been abandoned. The District Council required a considerable modification in the price at which the gas was offered to them; and as the Combine were not prepared to make it, the proposal fell through.

GAS COMPANIES' STOCK AND SHARE LIST.

The week just completed on the Stock Exchange may fairly be pronounced as an improvement on its predecessor, which was itself an advance on its forebears. At the start things did not look promising; but very soon more cheerful views prevailed. The Mexican bugbear seemed less terrifying; Continental bourses appeared to be calmer; and even the home labour question was regarded a shade more hopefully. In result, there is scarcely a market of any importance which does not show improvements in prices for the week, some of them being fairly considerable. Monday, however, opened in very poor spirits—impatient of the prolonged Mexican tension, and nervous about labour questions. It being Lord Mayor's Day, activity was repressed. Consols were not changed; but Rails and Transatlantics were depressed. Tuesday was dull and languid at the start, and prices were shaky. Consols dropped ¼ for the account. But later some improvement was initiated by foreign buying. Rails steadied, and Transatlantics were pushed up, while Foreign were pretty firm. Wednesday showed a decided improvement in tone; markets being more active and stronger—thanks largely to lessened apprehension regarding Mexican affairs. Consols were steady, Rails rose, Transatlantics were encouraged by good buying orders, and Foreign were well supported on the Continent. The course of Thursday was generally satisfactory, helped by the fortnightly settlement presenting no difficulties. Mexican matters ceased from troubling—temporarily. Government issues were firm, and Consols recovered their lost ¼ for the account. Rails were in fair demand, Foreign were good, and Transatlantics did quite well until sales in Wall Street rather lowered them. On Friday, markets for the most part were cheerful; Mexican news being brighter. Rails were nervous, however, over the labour outlook. Consols were stronger, though unchanged, and good advances were scored in many departments. Saturday was a very quiet day (the Gas Market counted only four transactions); but the tone was good, and some of the minor markets were quite buoyant. Consols closed at 72½ to 72¾—the same price as they had opened at. The Money Market shaped harder, and rates closed very firm. Business in the Gas Market was just a shade more active than the week before; but the premier Company had a good half of it. Prices were very firm; and a fair array of advanced quotations was the result. In Gaslight and Coke issues, the ordinary was in excellent demand; and from 101¾ on Monday it steadily advanced, until all the final transactions were at 103—a rise of ½. The secured issues also were active. The maximum realized 75½, the preference from 93½ to 95, and the debenture from 72 to 73¾. Little was done in South Metropolitan. Prices ranged from 108¼ to 109; and the debenture fetched 73½. In Commercials, the 4 per cent. changed hands at 105⅝ to 107, the 3½ per cent. at 102½ to 103⅜, and the debenture at 72¼ and 73. Among the Suburban and Provincial group, Brighton original fetched 203, British debenture 88 and 88½, South Suburban 116½ and 117, Wandsworth "B" 130½ and 131, and (on the local Exchange) Sheffield "B" 222. In the Continental companies, Imperial marked 166 to 167, ditto debenture 84½, European 17⅞ and 17 11/16, and Malta 4⅛. Among the undertakings of the remoter world, Bombay was done at 6 7/16, Melbourne at 97⅛, Oriental at 124⅛ to 125¾, Primitiva at 6, and ditto preference at 5.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 15	4	Alliance & Dublin Ord.	53–58	–5	6 17 11
374,000	,,	July 11	4	Do. 4 p.c. Deb.	80–83	..	4 16 5
280,000	5	Oct. 15	7½	Bombay, Ltd.	6¼–6¾	..	5 17 8
50,000	10	Aug. 28	15	Bourne- mouth Gas and Water — B 7 p.c.	28¾–29½	..	5 2 2
347,500	10	,,	7	Pref. 6 p.c.	13¾–13⅞	..	4 7 3
75,000	10	,,	6	Brentford Consolidated	262–267	..	5 4 10
880,000	Stk.	Aug. 14	14	Do. New	203–203	+1	5 5 9
330,000	,,	,,	11	Do. 5 p.c. Pref.	111–113	..	4 8 6
50,000	,,	,,	5	Do. 4 p.c. Deb.	94–96	..	4 3 4
206,250	,,	June 13	4	Brighton & Hove Orig.	201–206	..	5 6 10
217,380	Stk.	Aug. 18	11	Do. A Ord. Stk.	149–152	..	5 5 3
244,200	,,	,,	8	British	44½–45½	..	5 9 11
530,000	20	Sept. 16	12½	Do. 4 p.c. Deb. Stk.	87–89	..	4 9 11
120,000	Stk.	June 27	4	Buenos Ayres 4 p.c. Deb.	83½–91½	..	4 7 5
245,771	Stk.	,,	4	Cape Town & Dis., Ltd.	2–3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	3–5	..	—
100,000	10	—	—	Do. 4½ p.c. Deb. Stk.	75–80	..	5 12 6
100,000	Stk.	June 27	4½	Chester 5 p.c. Ord.	103–111	..	4 10 1
167,150	Stk.	Aug. 14	5	Commercial 4 p.c. Stk.	105–107	..	5 2 1
1,513,280	Stk.	Aug. 28	5/9/4	Do. 3½ p.c. do.	102–104	..	5 2 6
560,000	,,	,,	5½	Do. 3 p.c. Deb. Stk.	71½–73½	..	4 1 8
475,000	,,	June 13	8	Continental Union, Ltd.	79–82	..	5 9 9
800,000	Stk.	,,	4½	Do. 7 p.c. Pref.	124–126	..	5 11 1
200,000	,,	,,	7	Derby Con. Stk.	123–125	..	4 12 0
492,270	Stk.	—	1¾	Do. Deb. Stk.	102–104	..	3 16 11
55,000	,,	—	4	European, Ltd.	17⅝–18⅝	..	5 8 1
1,002,180	10	July 30	10	Gas- light and Coke — 4 p.c. Ord.	101½–103½	+½	4 14 1
16,386,660	Stk.	Aug. 14	4/17/4	3½ p.c. max.	74–77	..	4 10 11
2,600,000	,,	,,	3½	4 p.c. Con. Pref.	93–96	..	4 3 4
4,062,235	,,	,,	4	3 p.c. Con. Deb.	72–74	..	4 1 1
4,674,850	,,	June 13	3	Hastings & St. L. 3½ p.c.	88–90	+1	5 11 1
258,740	Stk.	Sept. 11	5	Do. do. 5 p.c.	—	..	—
82,500	,,	,,	6½	Hongkong & China, Ltd.	16⅜–17½	..	6 7 6
70,000	10	Oct. 15	11	Ilford A and C	150–153	..	4 19 8
131,000	Stk.	Sept. 11	7½	Do. B	118–120	..	5 2 1
65,780	,,	,,	6½	Do. 4 p.c. Deb.	£9–91	..	4 7 11
65,500	,,	June 27	4	Imperial Continental	160–165*	+1½	5 9 1
4,940,060	Stk.	Nov. 13	9	Do. 3½ p.c. Deb. Red.	83½–85½	..	4 1 10
1,235,000	Stk.	Aug. 14	3½	Lea Bridge Ord. 5 p.c.	118–121	..	5 3 4
300,242	Stk.	Aug. 28	6½	Liverpool United A	206–208	..	4 16 2
561,000	Stk.	,,	10	Do. B	145–147	..	4 15 3
718,100	,,	,,	7	Do. Deb. Stk.	94–96	..	4 3 4
306,083	,,	June 27	4	Maidstone 3 p.c. Deb.	66½–68½	..	4 7 7
63,480	Stk.	June 27	3	Malta & Mediterranean	4⅜–4⅞	..	6 3 1
250,000	100	Oct. 1	4½	Met. of Melbourne — 4½ p.c. Deb.	96–98	..	4 11 10
541,920	20	May 30	4	Monte Video, Ltd.	12–12½	..	6 8 0
1,775,892	Stk.	July 30	4½	Newc'tle&G'tesh'd Con.	99½–100	..	4 10 0
529,705	Stk.	June 27	3½	Do. 3½ p.c. Deb.	83½–84½	..	4 2 10
55,940	10	Aug. 28	1/10,6	North Middlesex 7 p.c.	12½–13½	..	5 11 5
300,000	Stk.	May 16	8	Oriental, Ltd.	124–129	..	6 4 0
60,000	5	Sept. 26	10	Ottoman, Ltd.	8–8½	..	5 17 8
60,000	50	Aug. 14	13	Portsea, Island B	127–130	+3	5 0 0
10,000	50	,,	12	Do. C	120–123	+1	4 17 7
249,980	5	Oct. 15	8	Primitiva Ord.	5⅞–6¼	..	6 8 0
499,960	5	June 27	5	,, 5 p.c. Pref.	4¼–5¼	..	4 17 7
521,600	100	June 2	4	,, 4 p.c. Deb.	93–95	..	4 4 3
346,198	Stk.	June 27	4	River Plate 4 p.c. Deb.	88–90	–1	4 8 11
275,000	5	Sept 26	12	San Paulo, Ltd.	—	..	—
150,000	10	,,	6	Do. 6 p.c. Pref.	11–11½	..	5 4 4
125,000	50	July 1	5	Do. 5 p.c. Deb.	49–51	..	4 18 0
135,000	Stk.	Aug. 28	10	Sheffield A	222–224	..	4 9 8
209,984	,,	,,	10	Do. B	221–223	..	4 9 8
523,500	,,	,,	10	Do. C	220–222	..	4 10 1
90,000	10	Oct. 15	7½	South African	9½–10½	..	7 2 10
6,429,895	Stk.	Aug. 14	5/9/4	South Met., 4 p.c. Ord.	108–110	..	4 19 4
1,895,445	,,	July 11	3	Do. 3 p.c. Deb.	72–74	..	4 1 1
209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	157–159	..	5 6 11
952,795	Stk.	,,	6	S'th Suburb'n Ord. 5 p.c.	115–117	..	5 2 7
60,000	,,	,,	5	Do. 5 p.c. Pref.	113–115	..	4 6 11
117,058	,,	June 27	5	Do. 5 p.c. Deb. Stk.	115–117	..	4 5 6
594,740	Stk.	Nov. 13	5	Southampton Ord.	100–103*	+½	4 17 1
120,000	Stk.	Aug. 14	7⅜	Tottenham and — A 5 p.c.	136–139	..	5 6 1
543,940	,,	,,	5⅞	B 3½ p.c.	114–116	..	5 1 3
149,470	,,	June 27	4	Edmonton — 4 p.c. Deb.	90–92	..	4 7 0
182,380	10	,,	5	Tuscan, Ltd.	5–6	..	8 6 8
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	96–98	..	5 2 0
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	111–113	..	4 8 6
				Wandsworth, Wimbledon, and Epsom—			
30,000	Stk.	Aug. 28	8⅜	Wandsworth A 5 p.c.	155–160	..	5 4 8
255,636	,,	,,	6¾	,, B 3½ p.c.	130–135	..	5 1 10
108,075	,,	,,	5/17/3	,, C 3½ p.c.	110–115	..	5 2 0
352,000	,,	,,	6½	Wimbledon 5 p.c.	111–116	..	5 5 7
98,000	,,	,,	6⅝	Epsom 5 p.c.	115–120	..	5 10 5
88,416	,,	June 27	3	3 p.c. Deb. Stk.	68–70	..	4 5 9

Prices marked * are "Ex-Div."

Price of Gas at Slaithwaite.—At a meeting of the Slaithwaite Urban District Council last Thursday, reference was made to the proposed amalgamation of the Longwood and Slaithwaite Gas Companies; it being stated that the general opinion of the Council seemed to be that they should receive better terms from the Longwood Company in return for amalgamation. Considerable discussion ensued in reference to the question, and it was eventually decided to support the amalgamation project on condition that when the new works of the Company come into operation the price of gas at Slaithwaite should be reduced 2d. per 1000 cubic feet in the first year and 3d. the following year, and that afterwards the price in the district should be uniform with that charged at Longwood.

Continental Union Gas Company, Limited.—The accounts of this Company for the year ended the 30th of June last, which will be submitted at the ordinary general meeting on the 2nd prox., show that the profits amount to £57,817. Adding the balance brought forward (£10,879), there is produced a total of £68,696. Of this sum, £7498 has been applied to the Messina amortization, and £7460 to the depreciation of investments—making together £14,958, and leaving £53,738 available for distribution. Interim dividends of 3½ and 2¼ per cent. on the preference and ordinary stock, both less tax, were paid in July; and the Directors propose to pay final dividends at these rates. After this is done, there will be left a carry-forward of £6654. The Directors report that the settlement with the Italian Government authorities has been successfully completed. Outstanding claims have been adjusted; and the Directors have written-off the balance of loss sustained at Messina by appropriating for the purpose the reserve fund of £40,000, and, as stated above, £7498 of the Company's undivided profits.

Gas Fatalities in Ireland.—William Dickson, a seafarer, and his wife were last Friday found dead in a bedroom of their house in Israel Street, Belfast; and in each instance death is attributed to gas poisoning. A smell of escaping gas attracted a neighbour, and when the house was broken into the discovery was made. "Death due to congestion of the brain induced by inhalation of coal gas" was the verdict of a Coroner's Jury at Dundalk on Thursday last in the case of Mrs. Mary Benn, of Bachelor's Walk in that town, who died in Louth Infirmary on the morning of that day. It appeared that the woman was found lying in bed breathing heavily. There were no gas-fittings in the house. Mr. George Airth, the Engineer and Manager of the Dundalk Gas Company, stated that the gas-main was about 20 feet from where deceased lay. If gas made its way into the house it must have been from a water-closet which was divided from the bedroom by a lath and plaster wall. A new sewer had been constructed at the place some months ago, and passed under the gas-main, which was 2 feet below the surface; but the Gas Company received no notice of this. John Copas said he found the pipe sagged where the new sewer had been constructed, and it looked as if it had been plastered with clay. This, however, was not done by the Gas Company.

The existing flat-flame burners in the wards of the Winter Street Hospital, Sheffield, are to be converted into incandescent burners of the Bland type; and the work is to be carried out by the Sheffield Gas Company.

The following appeared in the "Financial News" last Saturday: "As a consequence of the Dublin chaos, Alliance and Dublin Gas ordinary stock has fallen considerably. Last Saturday [the 8th] it was 58-63, and last night 53-58. Dublin is glutted with gas."

The central electric power station at the works of Messrs. Vickers, Limited, in Sheffield, was set on fire last Thursday by the fusing of a wire. Fortunately the outbreak was subdued in less than an hour; but the works served by the station had to be closed-down.

A number of shares in the Eton Gas Company fetched very good prices at a sale conducted by Mr. Howard J. Hetherington at the Bridge House Hotel, Eton, last Wednesday. They were fully-paid £15 "A" shares, and were sold at from £31 10s. to £32 each.

On the evening of Saturday, the 8th inst., there was a failure of the electric light at Hastings. Referring to the matter, a correspondent of the "Hastings and St. Leonards Observer" last Saturday suggested to the Public Lighting Committee of the Corporation "that when converting the public lamps from gas to electricity each alternate lamp be allowed to remain lighted by gas. This would," he said, "prevent the likelihood of accident in the event of another failure, as it was absolutely dangerous to walk down to the town last Saturday evening. If an accident had occurred, surely the Corporation would be liable for damages."

We have received from Messrs. J. & W. B. Smith, of Farringdon Road, E.C., their new booklet bearing the title of "Shop Lighting Up to Date." It embodies all the latest gas appliances used for this purpose, and will be found useful to gas managers in the coming season, when shopkeepers will doubtless be turning their attention to making the lighting of their premises more effective. The booklet has a coloured wrapper, the back page of which is devoted to a comparison of the lighting costs and efficiencies of gas and electricity, extracted from Mr. Jacques Abady's lecture to the North of England Association early last year.

The London Chamber of Commerce discussed last Tuesday, after a dinner at the Trocadero Restaurant, the subject of "Voluntary Conciliation and Arbitration in Labour Disputes." Mr. J. Faithfull Begg presided, and in the course of his remarks stated that the settled policy of the Chamber for more than twenty years had been to encourage conciliation and arbitration by every means. The number of voluntary Conciliation and Arbitration Boards in the country last year was 297; and in addition many cases were dealt with by the Labour Department of the Board of Trade. He had come to the conclusion that it was in the creation of suitable machinery for the purpose of conciliation and arbitration that their brightest hopes lay for satisfactory progress in regard to the settlement of disputes.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

TECHNICAL ASSISTANT. Hexham Gas Company.
SUPERINTENDENT, &c. Arbroath Gas Undertaking.
TRAVELLER. No. 5807.
CONDUCT OF LONDON OFFICE. No. 5806.
LEADING STOKER AND STOKERS. Sittingbourne Gas-Works.

Appointment Wanted.

REPRESENTATIVE. No. 5813.

Books (Second-Hand) for Disposal.

"TRANSACTIONS" INSTITUTION GAS ENGINEERS, INSTITUTION OF WATER ENGINEERS, &c. "S. S.," c/o Horncastle's.

Gas-Works Wanted.

D.G., c/o Scripps's Advertising Offices.

Plant, &c. (Second Hand), for Sale.

RETORTS AND MOUTHPIECES. Newcastle-on-Tyne Gas Company.

Stocks and Shares, Sales of.

BOGNOR GASLIGHT COMPANY. London Mart. Dec. 2.
BRENTWOOD GAS COMPANY. London Mart. Dec. 2.
GRAYS AND TILBURY GAS COMPANY. London Mart. Dec. 2.
HARROW AND STANMORE GAS COMPANY. London Mart. Dec. 2.
SHIREBROOK AND DISTRICT GAS COMPANY. Norfolk Place, Nottingham. Nov. 26.
SOUTHEND WATER COMPANY. London Mart. Dec. 2.
TITCHFIELD GAS COMPANY. London Mart. Dec. 2.
WANDSWORTH, &c., GAS COMPANY. London Mart. Nov. 25.

TENDERS FOR

Coal.

NOTTINGHAM CORPORATION. Tenders by Dec. 4.

Fire-Clay Goods.

BRADFORD CORPORATION. Tenders by Nov. 20.

Gasholder, &c.

KEIGHLEY GAS DEPARTMENT. Tenders by Nov. 27.

General Stores (Bricks, Plumbing, &c. Sulphuric Acid, Cement, Lime, Earthenware Pipes, Castings, Gravel, Stones, &c., Ironmongery, Picks, Shovels, &c., Disinfectants, Timber, &c.).

NOTTINGHAM CORPORATION. Tenders by Dec. 4.
SALFORD GAS DEPARTMENT.

Retort Bench Fittings, Mains, Mouthpieces, &c.

SHEFFIELD GASLIGHT COMPANY. Tenders by Dec. 2.

Tar, Pitch, and Cresote Oil.

NOTTINGHAM CORPORATION. Tenders by Dec. 4.

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For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

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"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
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North of England, Midlands, and Wales:
J. BROWN & CO., LTD., Savile Town, DEWSBURY.
Scotland and Ireland:
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

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"KLEENOFF." THE COOKER CLEANER.
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